Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Wang Y, Eldridge N, Metersky ML, et al. National trends in patient safety for four common conditions, 2005–2011. N Engl J Med 2014;370:341-51. DOI: 10.1056/NEJMsa1300991

National Trends in Patient Safety for Four Common Conditions, 2005 to 2011
Supplementary Appendix

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Appendix A: Brief Description of MPSMS Hospital Sampling

The MPSMS data was derived from two CMS data sources: 1) the Hospital Payment Monitoring Program (HPMP), which provided data from 2002 to 2007, and 2) the Hospital Inpatient Quality Reporting Program (IQR), which provided data from 2009 to 2011. Hospitals that do not participate in the IQR initiative will receive a 2% reduction in their Medicare Annual Payment Update for the following fiscal year. The main differences between the HPMP-based MPSMS sample and IQR-based MPSMS sample are described below (see also Table S3):

1. **Condition**: HPMP included all cause medical and surgical procedures, but IQR only included four common conditions (AMI, CHF, pneumonia, and major surgical procedures as defined in the Surgical Care Improvement Program [SCIP]). For this study, we included only the HPMP records that met the case definitions for the AMI, CHF, pneumonia, or SCIP samples.

2. **Patients:** HPMP was restricted to Medicare fee-for-service patients whereas IQR includes all patients regardless of payer. The IQR-based MPSMS data has a variable to indicate whether a patient is in the Medicare fee-for-service program or not. We used this variable along with patient's age to restrict the IQR data to those patients who were in the fee-for-service program during our study period. Thus, all patients in our study sample were in the Medicare fee-for-service program.

3. **Hospital**: HPMP gathered data from all acute-care hospitals (more than 4,000); the 2009 IQR program gathered data from all participating acute-care hospitals (approximately 3,800). Hospitals eligible for the IQR program are defined elsewhere (http://www.ssa.gov/OP_Home/ssact/title18/1886.htm). In 2010, IQR changed its

sampling design. One random sample of 800 hospitals provided data for Quarters 1-3, 2010. A second random sample of 800 hospitals provided Quarter 4, 2010 through Quarter 3, 2011 data. A third sample provided Quarter 4, 2011 data. In total, approximately 1,400 hospitals were included per year in the 2010 and 2011 IQR-based MPSMS samples. Although the 2010-2011 samples changed mid-year, all analyses in this study were conducted by calendar year.

4. **Sample size**: The HPMP-based MPSMS sample included approximately 26,000 cases for each year of 2005 to 2007. The 2009 IQR-based MPSMS sample consisted of approximately 18,000 cases, and the 2010 and 2011 IQR-based MPSMS sample consisted of approximately 34,000 cases per year.

5. **Sampling**: HPMP-based cases were randomly selected by state and month from the Medicare National Claims History database (containing nearly 13 million annual Medicare fee-for-service hospital discharges). Every month, the same number of discharges was randomly selected from each state. From January 1, 2002 to December 31, 2002, 93 hospital discharges were randomly selected monthly from 49 states, Washington DC, Puerto Rico, and the Virgin Islands, as well as 42 discharges from Alaska. From 2003 to 2007, the sample size was reduced to 42 discharges per state per month. The 2009 IQR-based MPSMS sample consisted of 6,000 randomly selected cases (1,000 AMI, 1,000 CHF, 2,000 pneumonia, and 2,000 conditions requiring surgery cases) from all IQR participating hospitals per quarter. Only the first three quarters of 2009 data were available. No cases were selected from the 4^{th} quarter of 2009. The 2010 and 2011 IQR-based MPSMS samples consisted of 8,500 cases with 100% pneumonia and conditions requiring surgery cases included first. The remaining cases were divided as

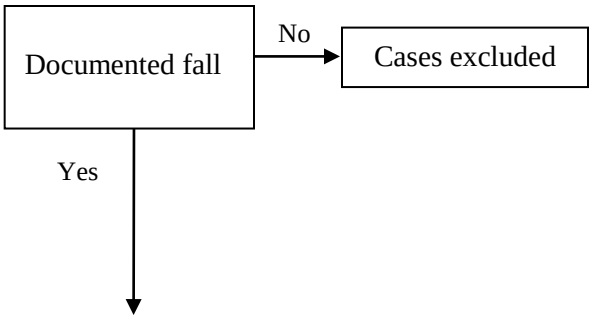
follows: 50% AMI and 50% CHF from 800 randomly selected hospitals per quarter. In the 2010 and 2011 IQR-based sample, for each quarter, all 800 hospitals could contribute an equal number of cases.

Our final study sample consists only of Medicare patients aged 65 years or older, who were discharged with at least one of the four conditions: AMI, CHF, pneumonia, or conditions requiring surgery as defined by SCIP criteria.

Appendix B: Measure Algorithms

Inpatient Falls

Hospital Discharges



 # Patients who fell at least once during hospital stay

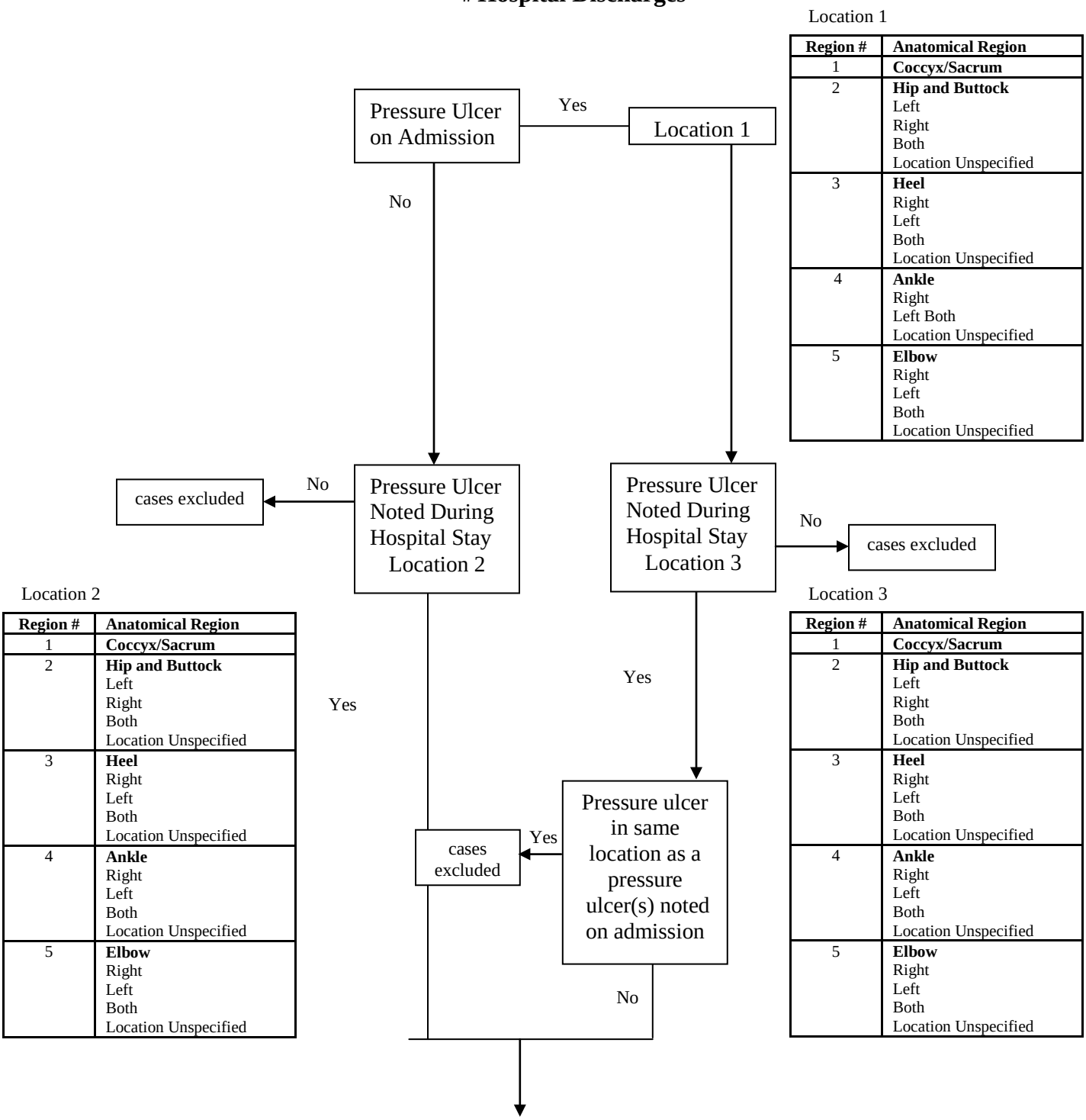
Notes:

- # patients who had a new fracture documented the day of the fall or after the fall during the hospital stay.
- # patients who had a subdural hematoma documented the day of the fall or after the fall during the hospital stay.
- # patients who had both a new fracture and subdural hematoma documented the day of the fall or after the fall during the hospital stay.

Please note that additional injuries associated with falls were collected for the 2011 sample patients. # other types of injuries associated with a fall were abstracted:

- # patients had one of the following new injuries: bruising, hematoma, laceration without sutures, pain or a sprain documented on the day of, or the day after the fall.
- # patients had a new laceration requiring sutures/staples documented on the day of, or the day after the fall
- # patient had a new dislocation of bone/joint documented on the day of, or the day after the fall

Hospital-Acquired Pressure Ulcers (HAPrU)



Location 1

Region #	Anatomical Region
1	**Coccyx/Sacrum**
2	**Hip and Buttock** Left Right Both Location Unspecified
3	**Heel** Right Left Both Location Unspecified
4	**Ankle** Right Left Both Location Unspecified
5	**Elbow** Right Left Both Location Unspecified

Location 2

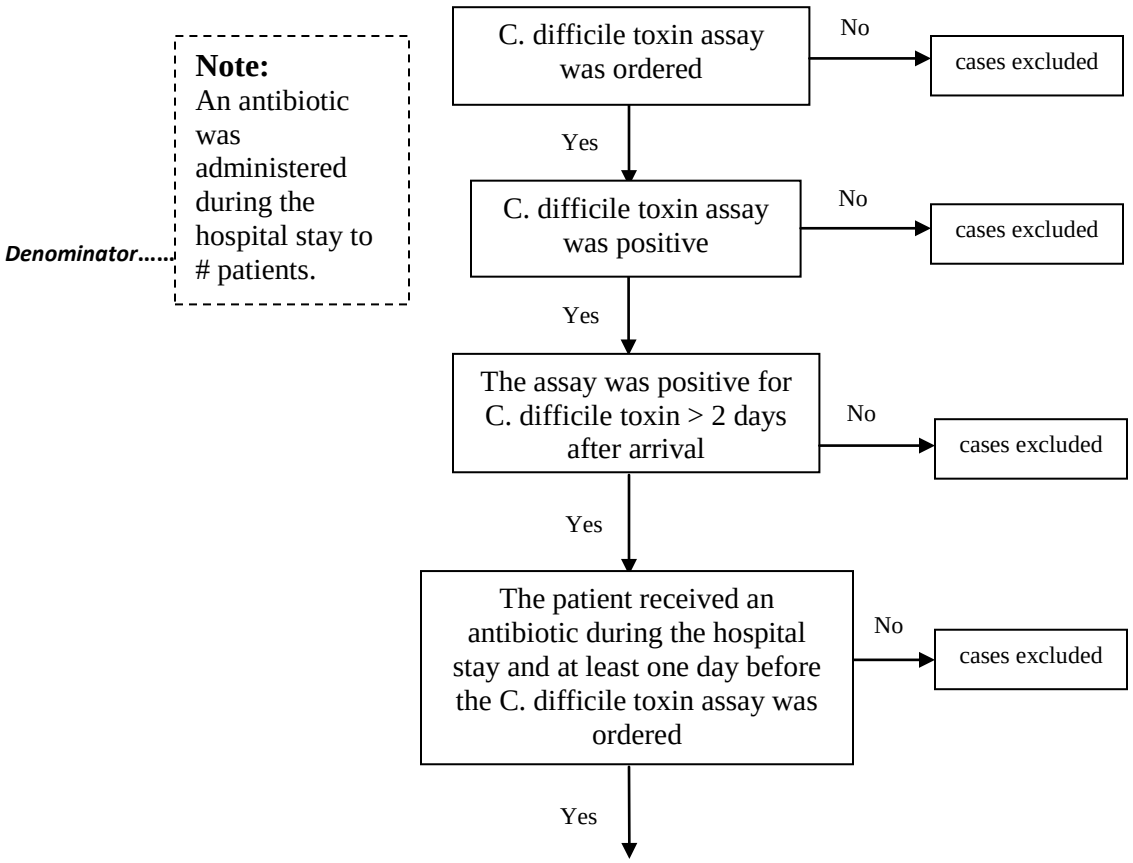
Region #	Anatomical Region
1	**Coccyx/Sacrum**
2	**Hip and Buttock** Left Right Both Location Unspecified
3	**Heel** Right Left Both Location Unspecified
4	**Ankle** Right Left Both Location Unspecified
5	**Elbow** Right Left Both Location Unspecified

Location 3

Region #	Anatomical Region
1	**Coccyx/Sacrum**
2	**Hip and Buttock** Left Right Both Location Unspecified
3	**Heel** Right Left Both Location Unspecified
4	**Ankle** Right Left Both Location Unspecified
5	**Elbow** Right Left Both Location Unspecified

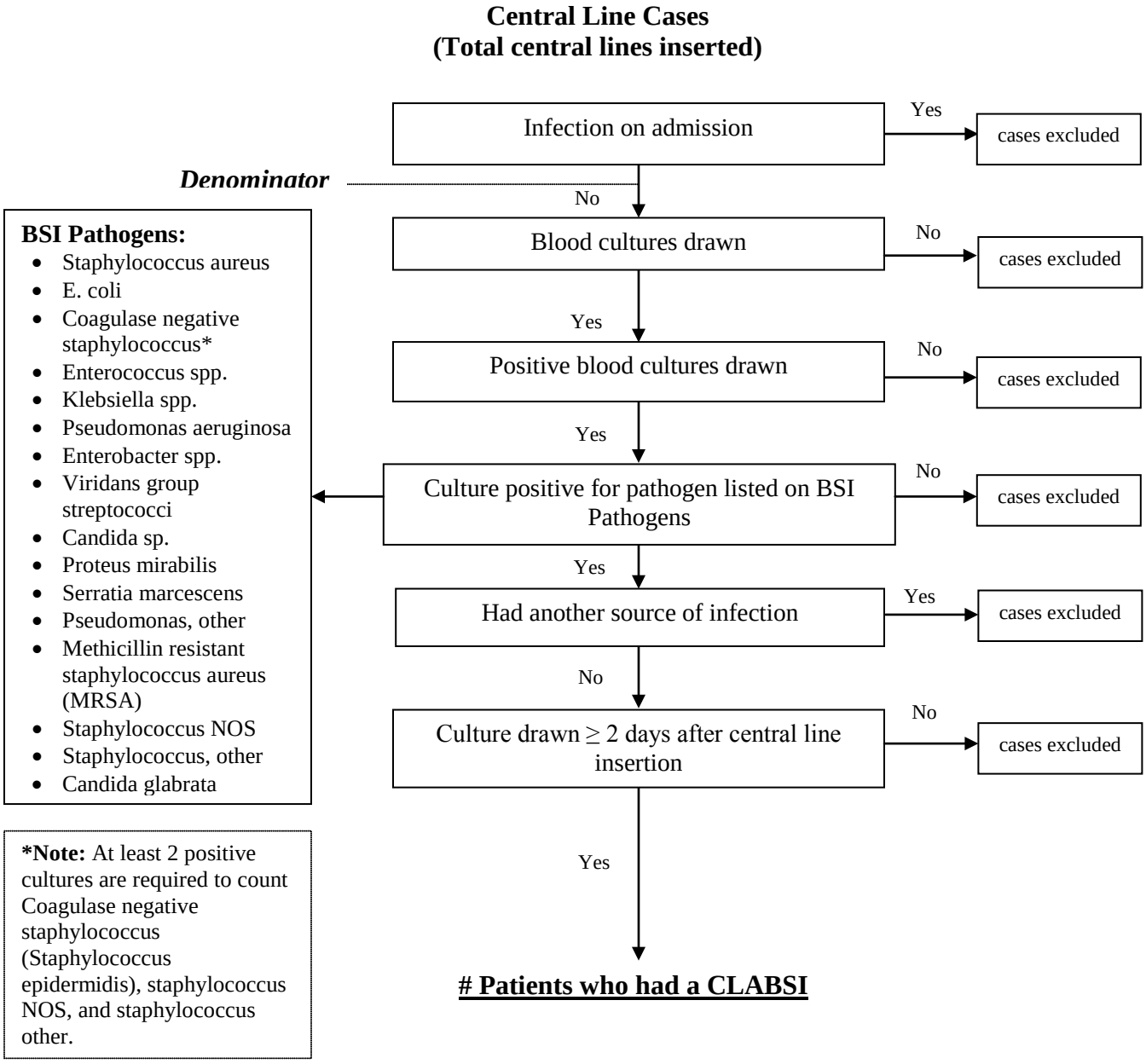
Hospital-Acquired Antibiotic-Associated Clostridium difficile (C. diff)

 # Hospital Discharges

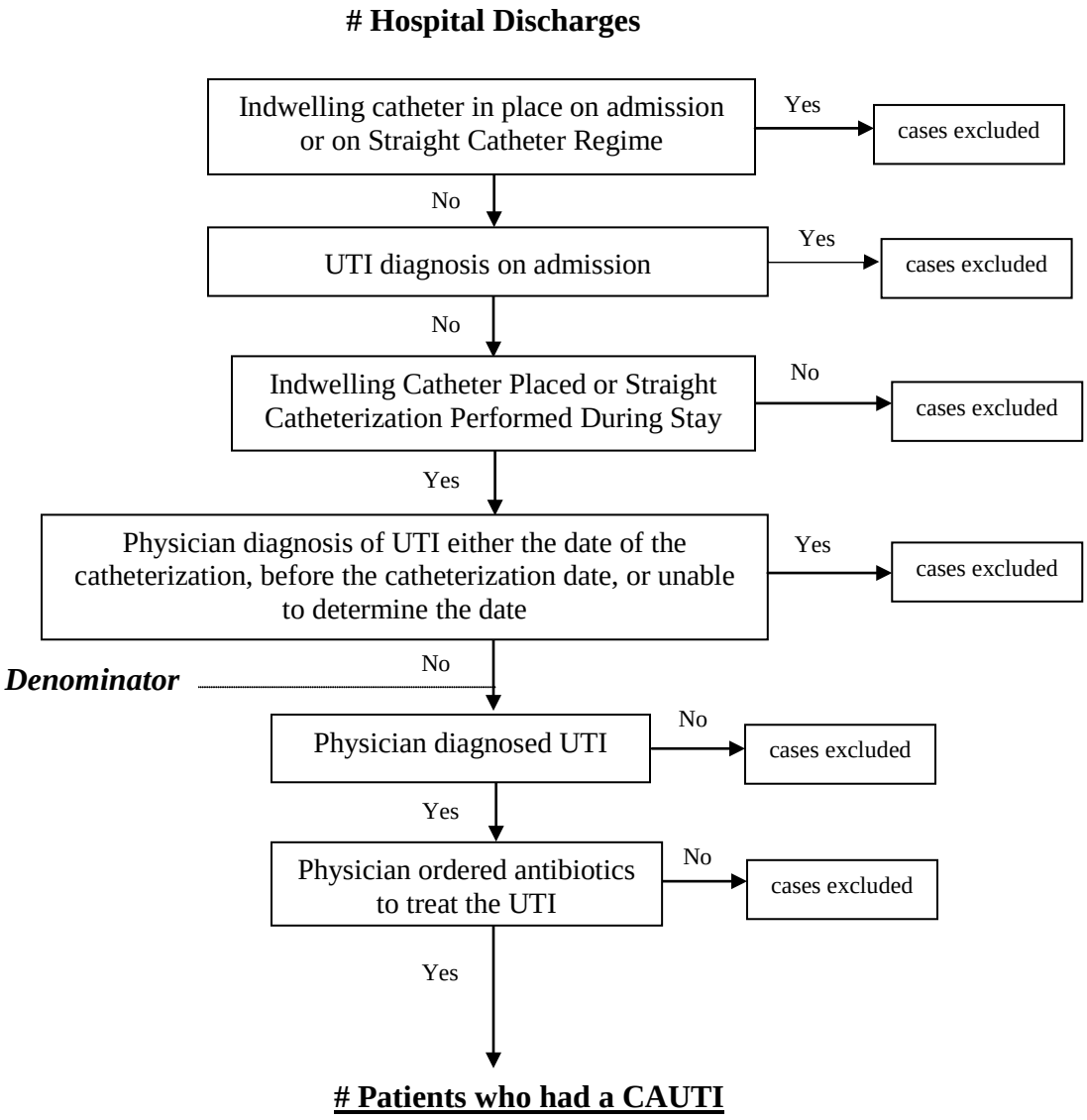


 # Patients who had Hospital-Acquired Antibiotic-Associated C. difficile

Central Line-Associated Bloodstream Infections (CLABSI)

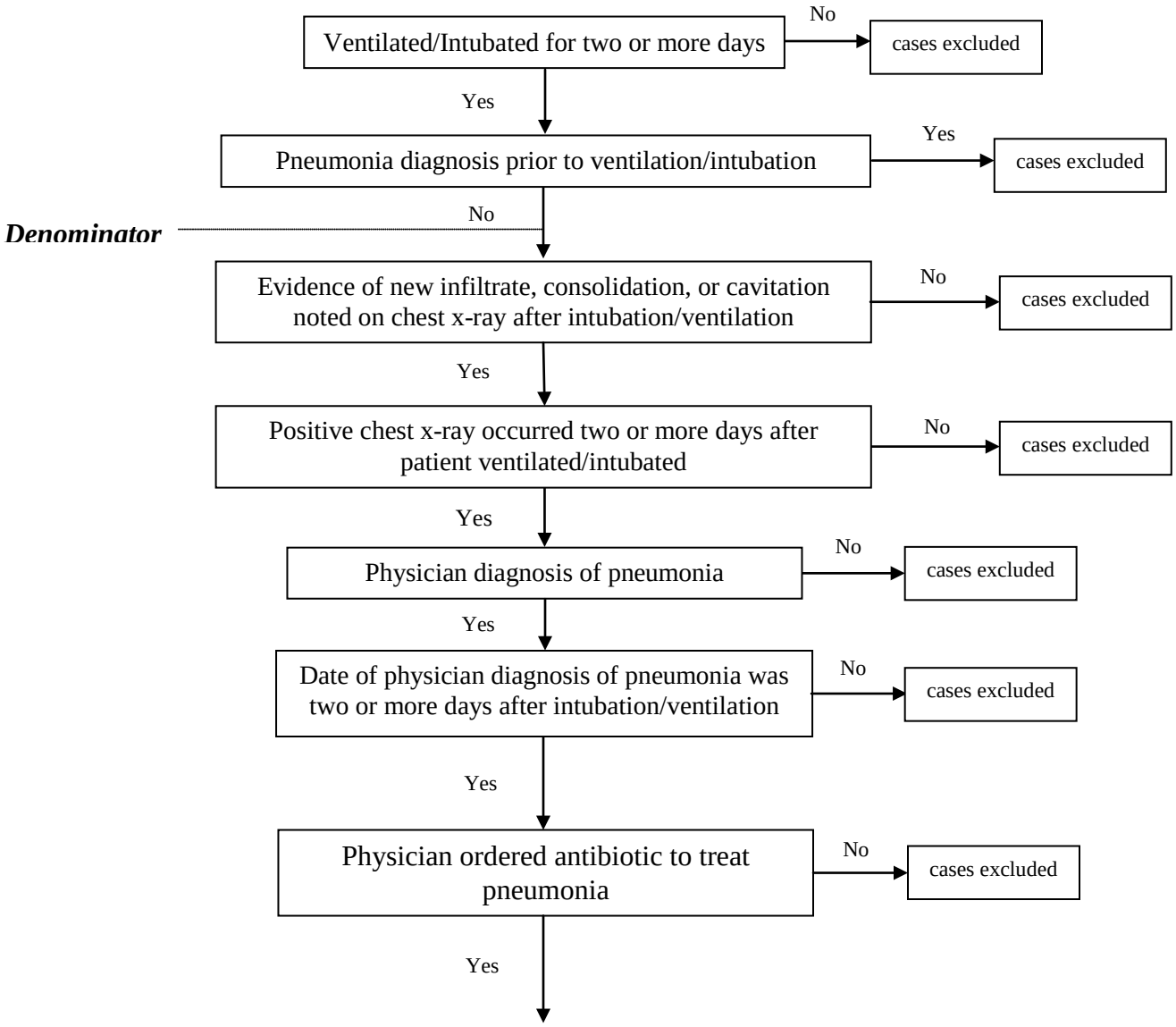


Catheter-Associated Urinary Tract Infection (CAUTI)



Ventilator-Associated Pneumonia (VAP)

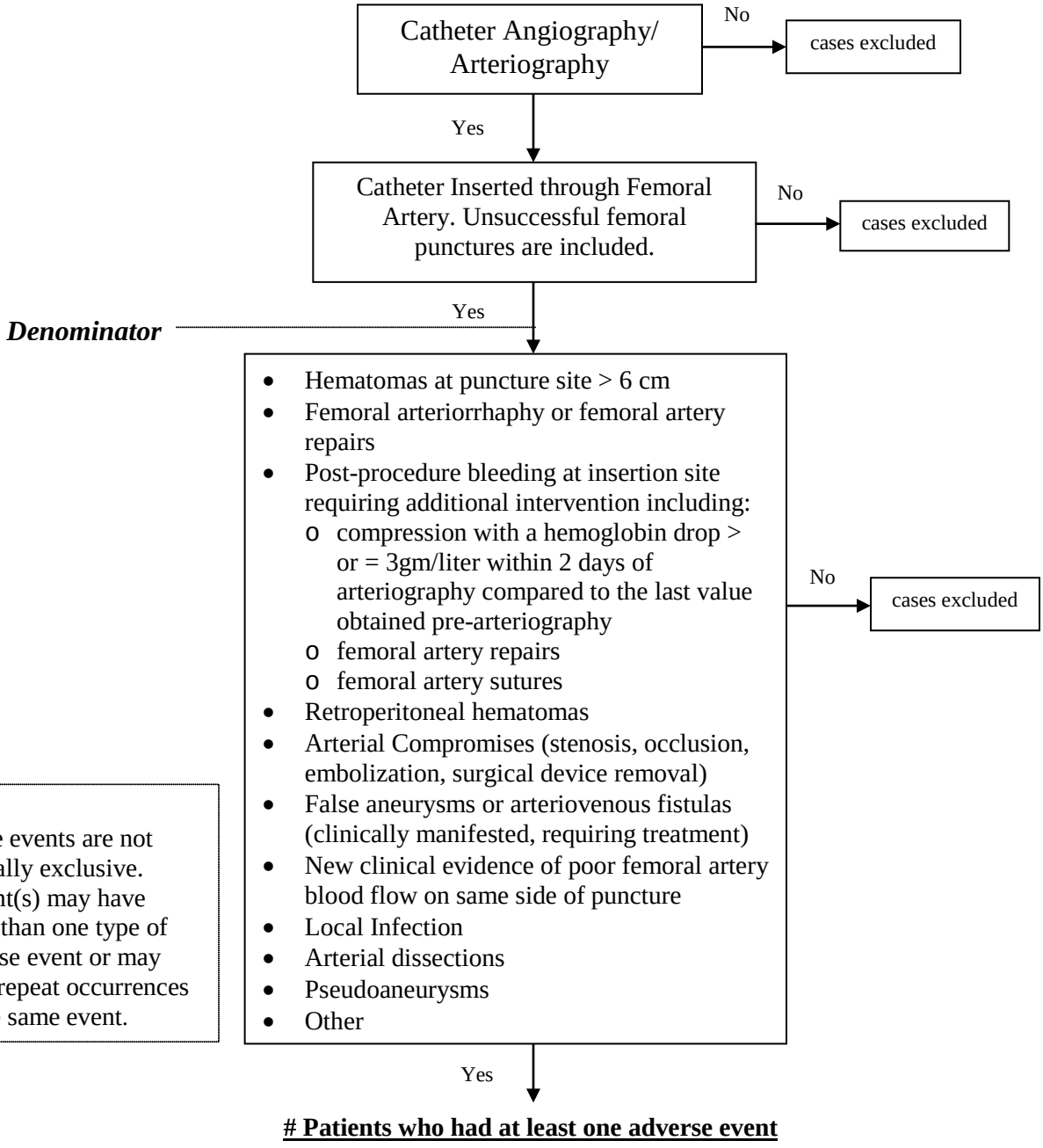
 # Mechanically Ventilated Cases



 # Patients who had Ventilator-Associated Pneumonia

Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures (FAPCAP)

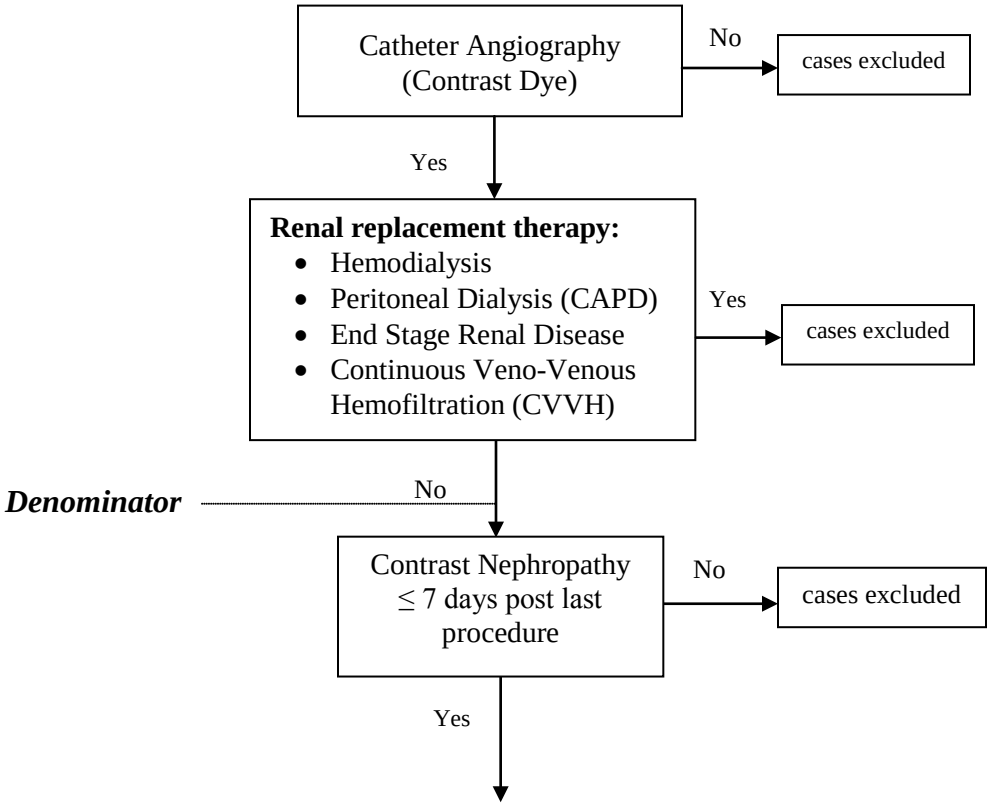
 # Hospital Discharges



Note:
These events are not mutually exclusive. Patient(s) may have more than one type of adverse event or may have repeat occurrences of the same event.

Contrast Nephropathy[1] Associated with Catheter Angiography (CNACA)

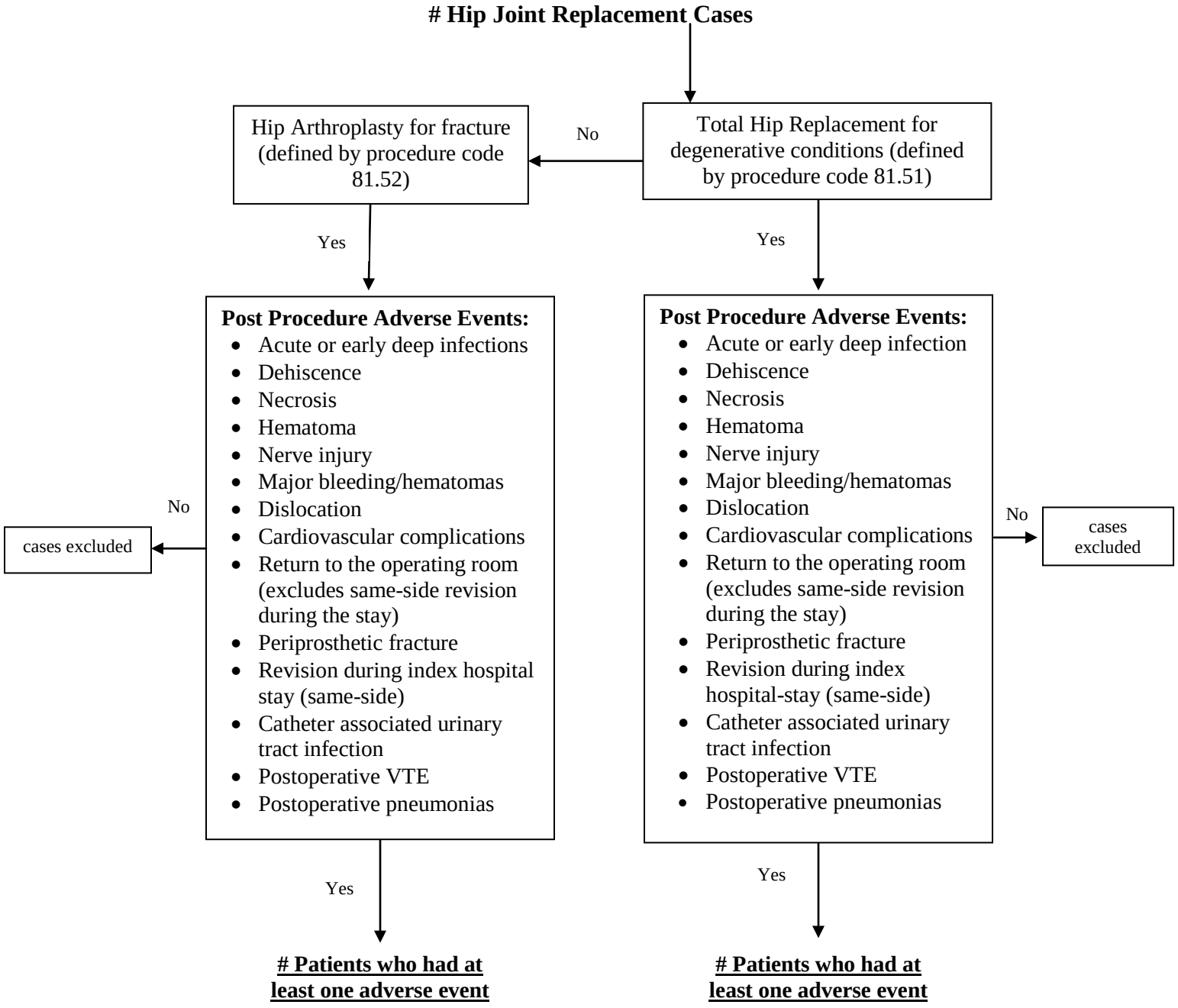
 # Hospital Discharges



 # Patients who had Contrast Nephropathy after a Catheter Angiography

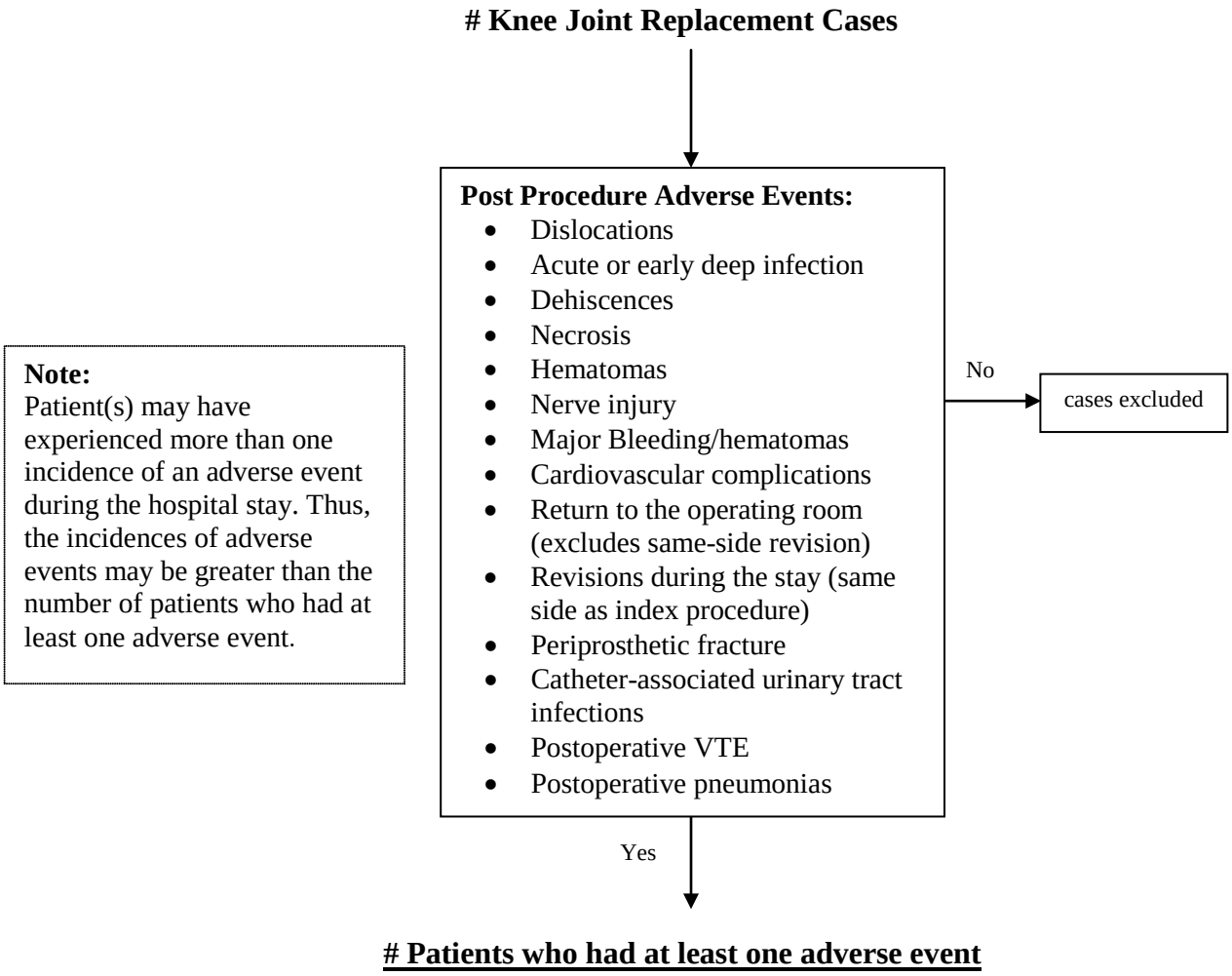
Contrast Nephropathy is defined as an absolute increase in serum creatinine of more than 0.5 mg/dL or a relative increase in serum creatinine of more than 25% of its level before administration of contrast medium within seven days post-procedure.

Adverse Events Associated with Hip Joint Replacement



Note:
Patient(s) may have experienced more than one incidence of an adverse event (AE) during the hospital stay. Thus, the incidences of AEs may be greater than the number of patients who had at least one AE.

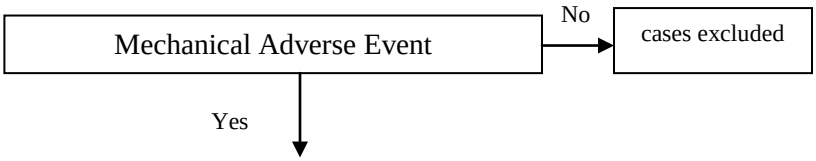
Adverse Events Associated with Knee Joint Replacement
(defined by procedure code 81.54)



Note:
Patient(s) may have experienced more than one incidence of an adverse event during the hospital stay. Thus, the incidences of adverse events may be greater than the number of patients who had at least one adverse event.

Mechanical Complications Associated with Central Lines

 # Central Line Cases
(Total central lines inserted)



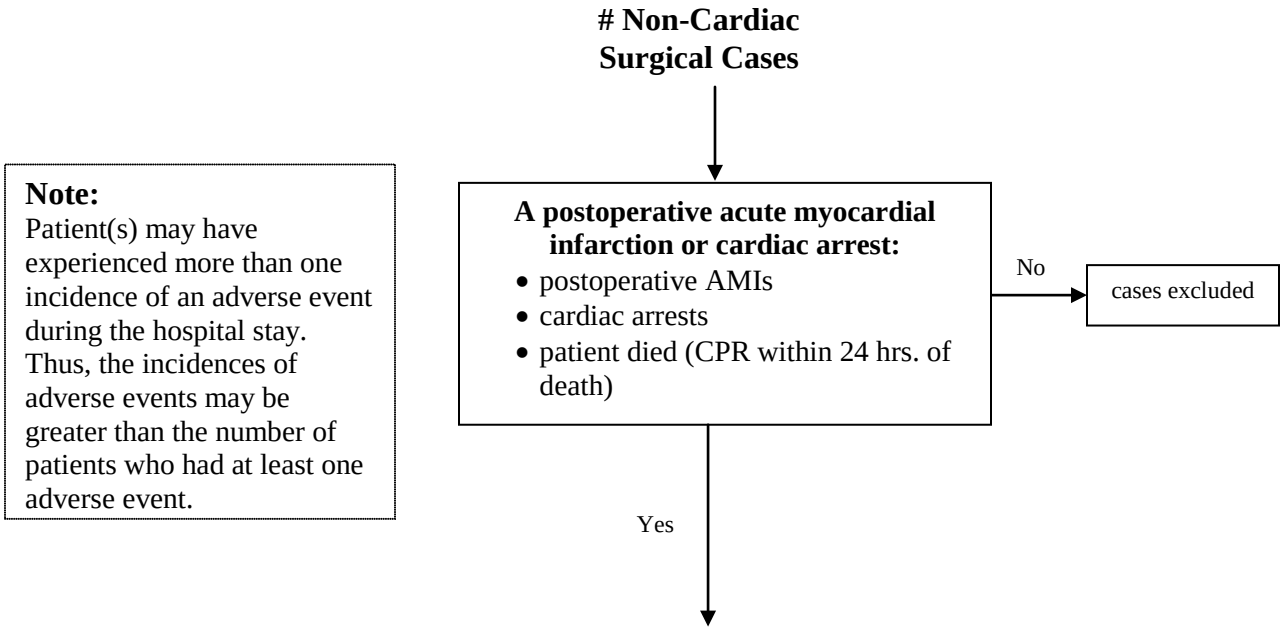
 # Patients who had at least one Mechanical Adverse Event

Type of Adverse Event:

- Allergic reaction (only when CPR within 15 minutes of catheter insertion)
- Arrythmias
- Perforations
- Pneumothoraxes
- Hematomas/bleeding
- Shearing off of catheter
- Air embolism
- Misplaced catheters
- Thromboses/embolisms
- Knotting of pulmonary artery catheter
- Bleeding
- Catheter occlusion
- Leaking
- Other

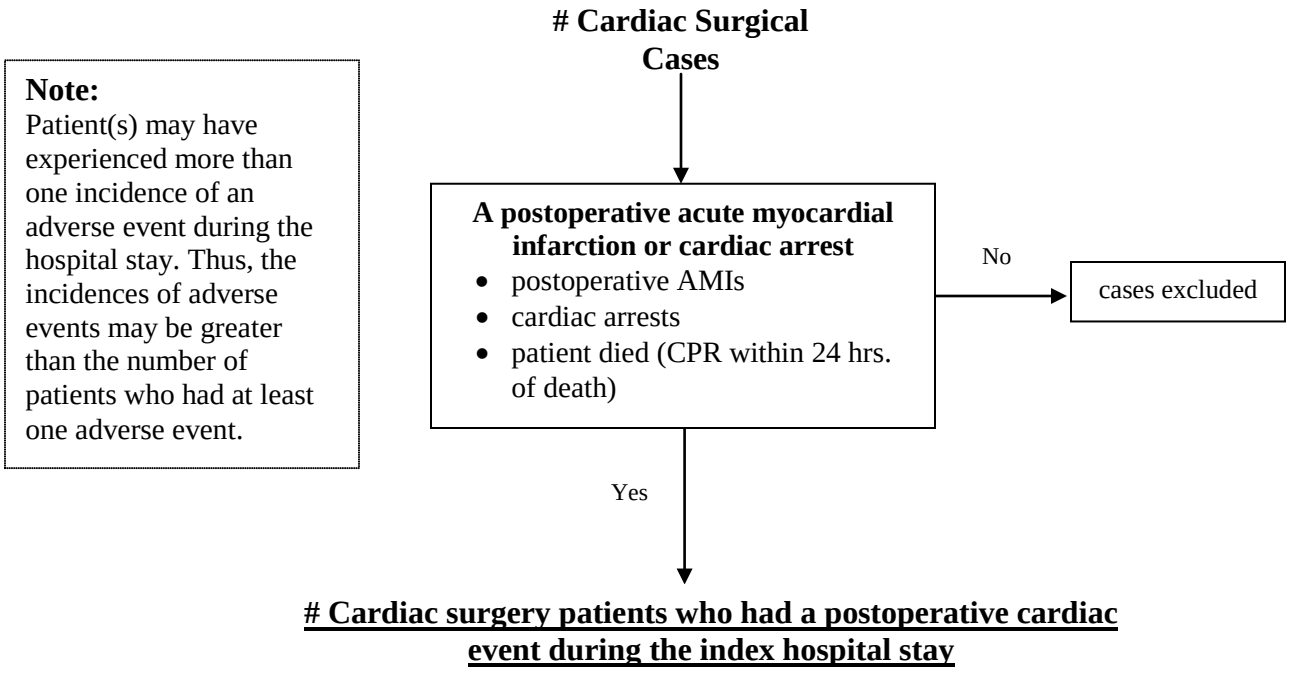
Note:
Patient(s) may have experienced more than one incidence of an adverse event during the hospital stay. Thus, the incidences of adverse events may be greater than the number of patients who had at least one adverse event.

Postoperative Cardiac Events
Non-Cardiac Surgical Cases



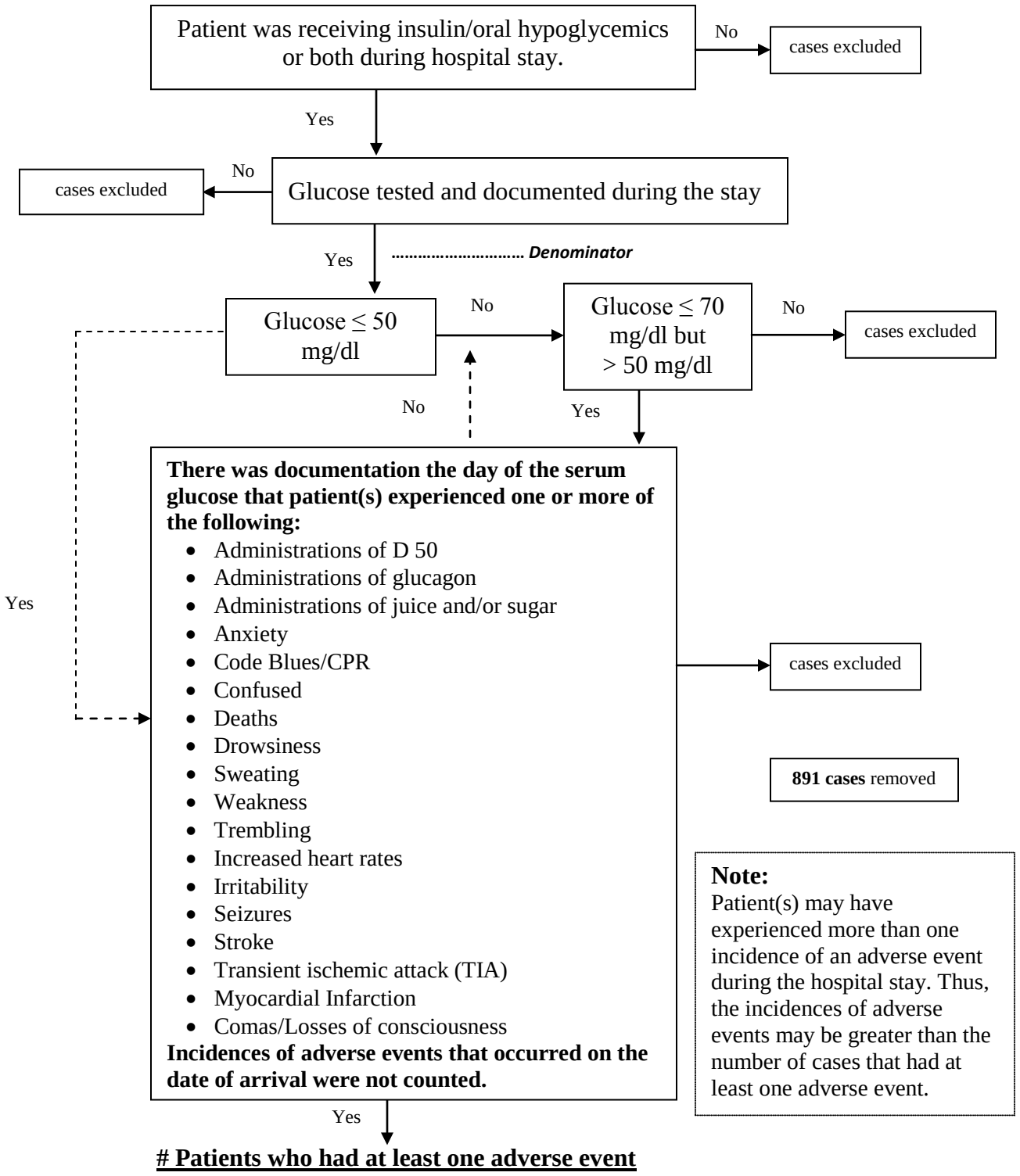
 # Non-cardiac surgery patients who had a postoperative cardiac event during the index hospital stay

Postoperative Cardiac Events
Cardiac Surgical Cases



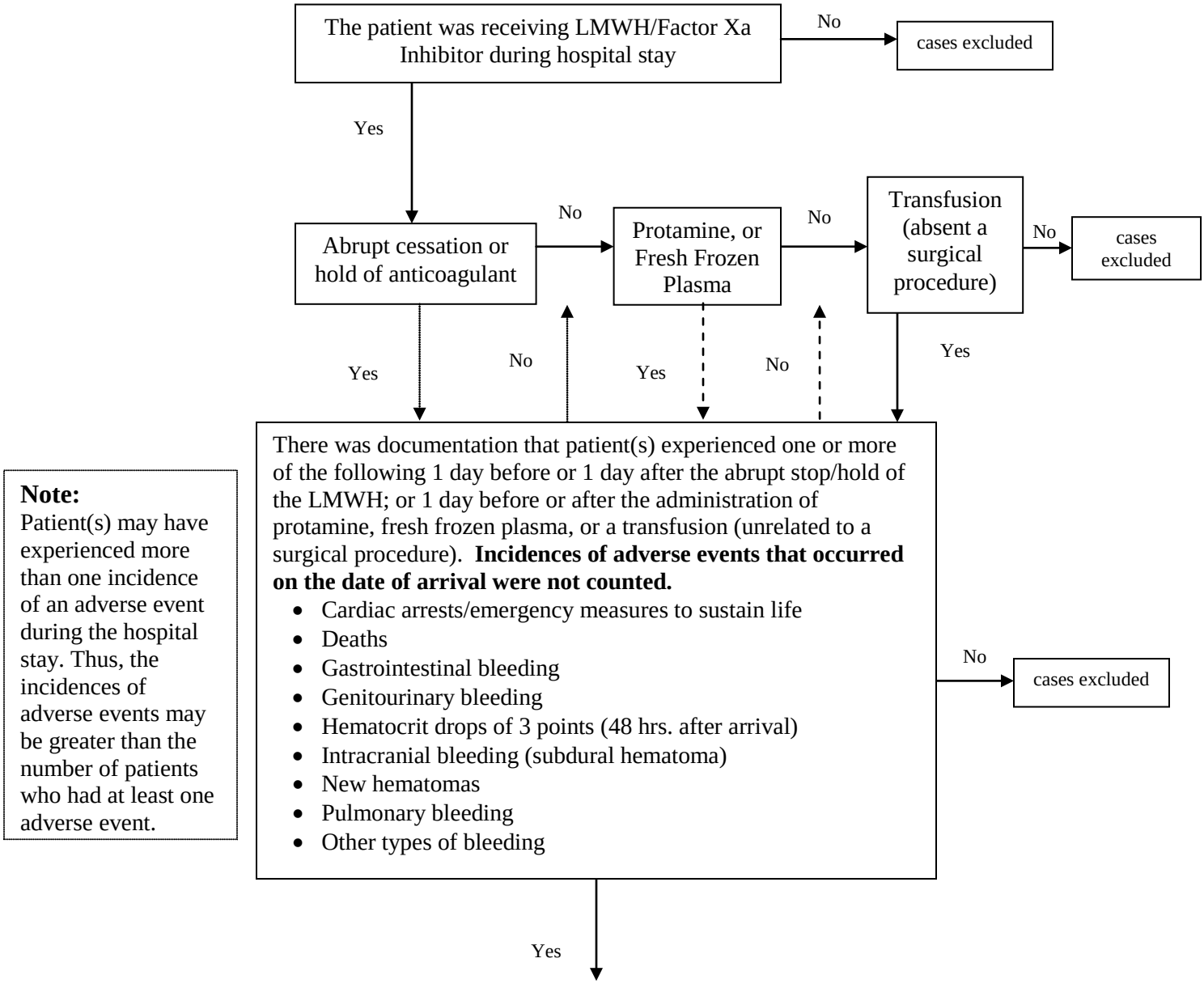
Adverse Events Associated with Hypoglycemic Agents: Insulin/Oral Hypoglycemics/Combination of Both

 # Hospital Discharges



Adverse Events Associated with Low Molecular Weight Heparin (LMWH) and Factor Xa Inhibitor

 # Hospital Discharges

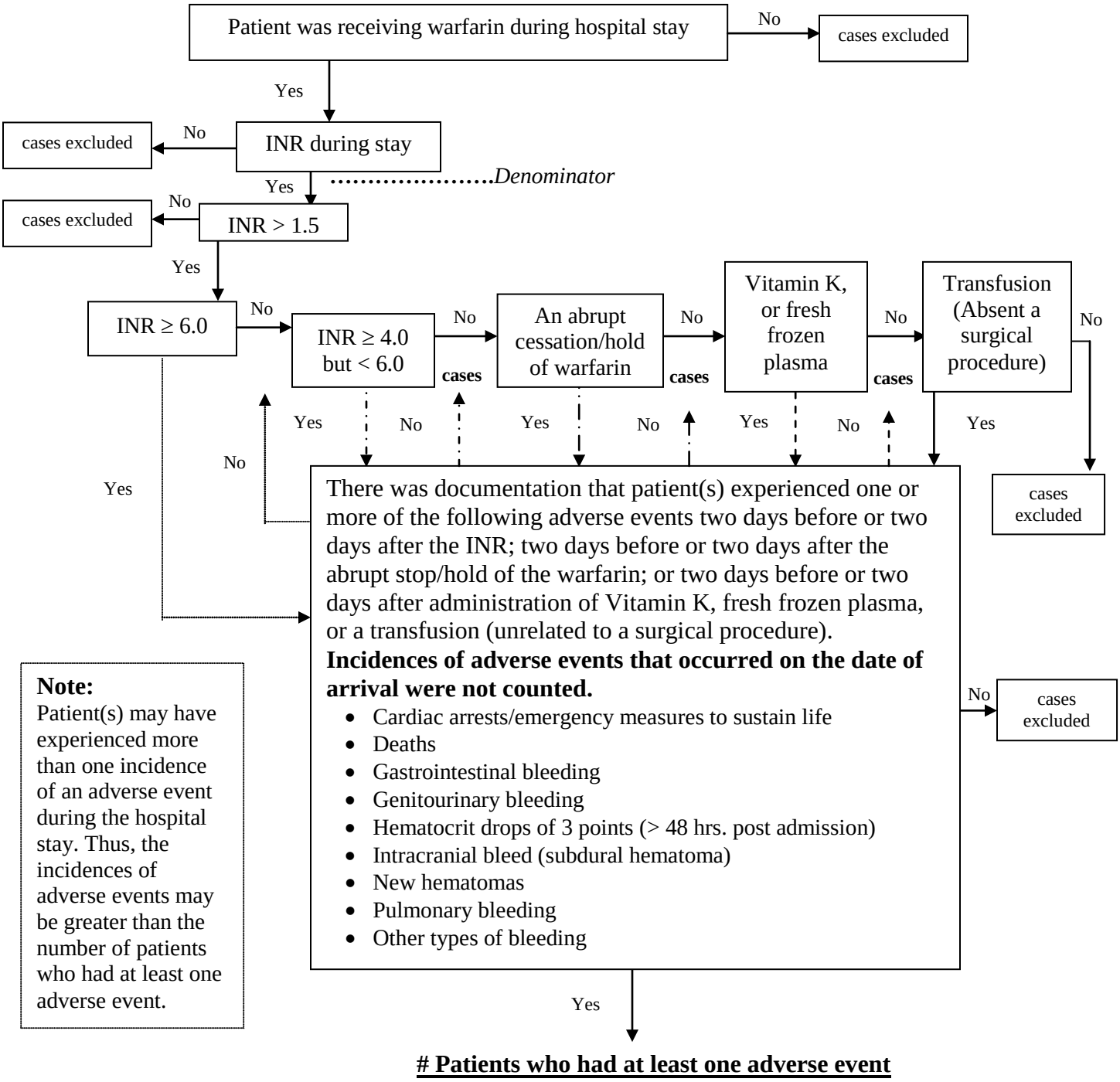


Note:
Patient(s) may have experienced more than one incidence of an adverse event during the hospital stay. Thus, the incidences of adverse events may be greater than the number of patients who had at least one adverse event.

 # Patients who had at least one adverse event

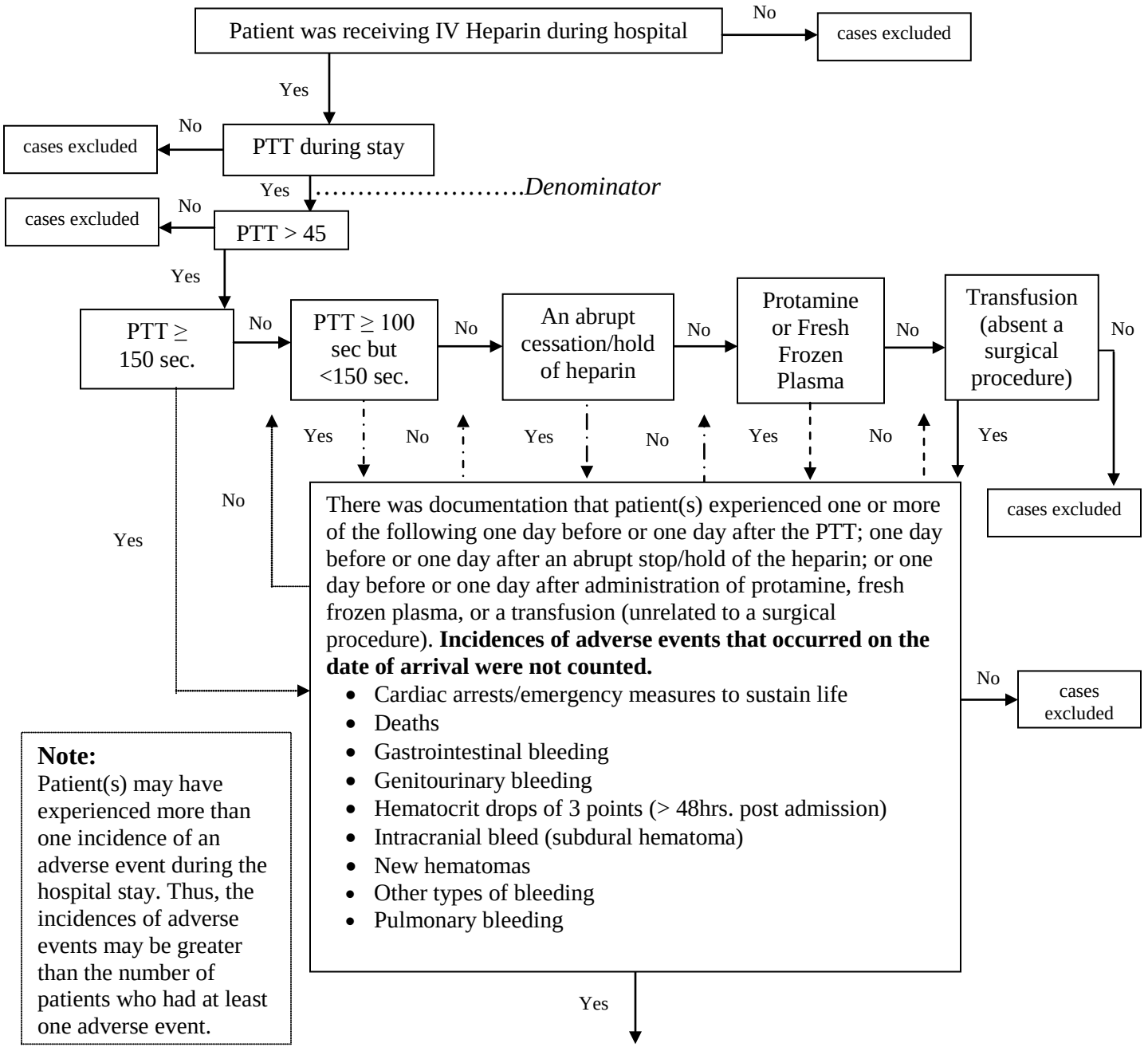
Adverse Events Associated with Warfarin

 # Hospital Discharges



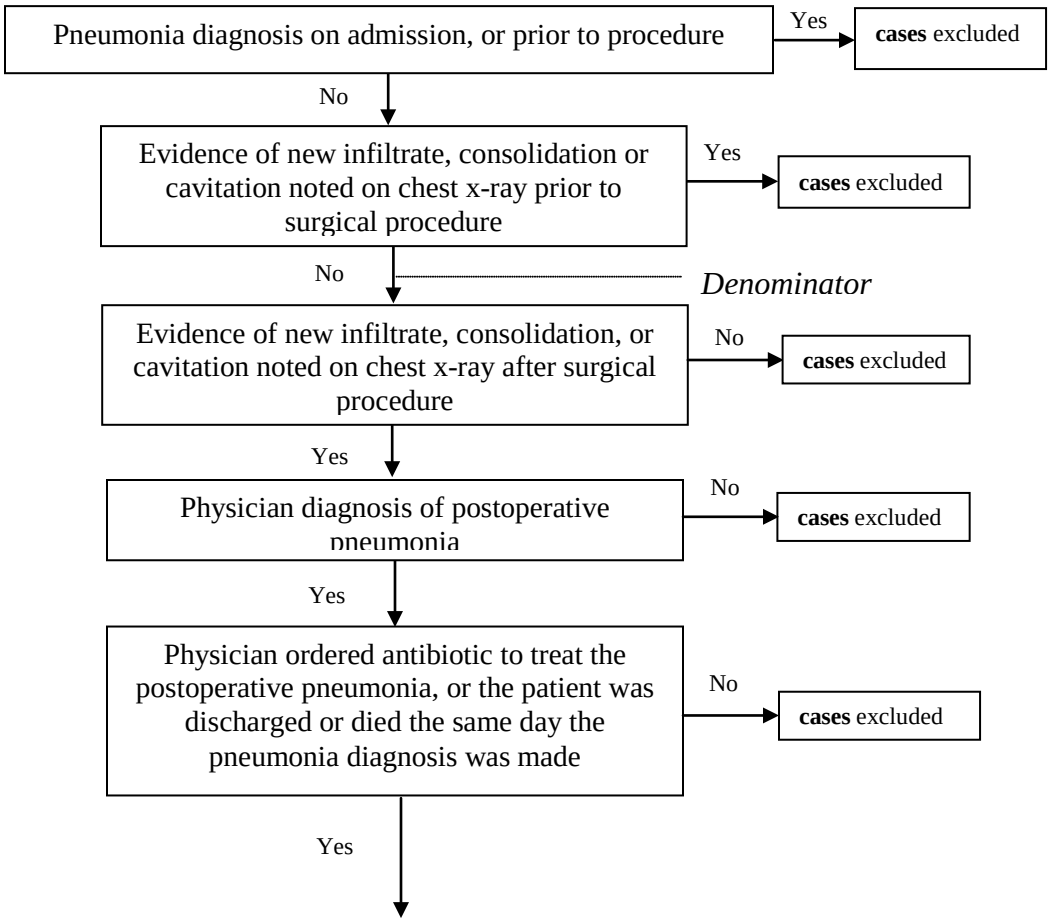
Adverse Events Associated with IV Heparin

 # Hospital Discharges



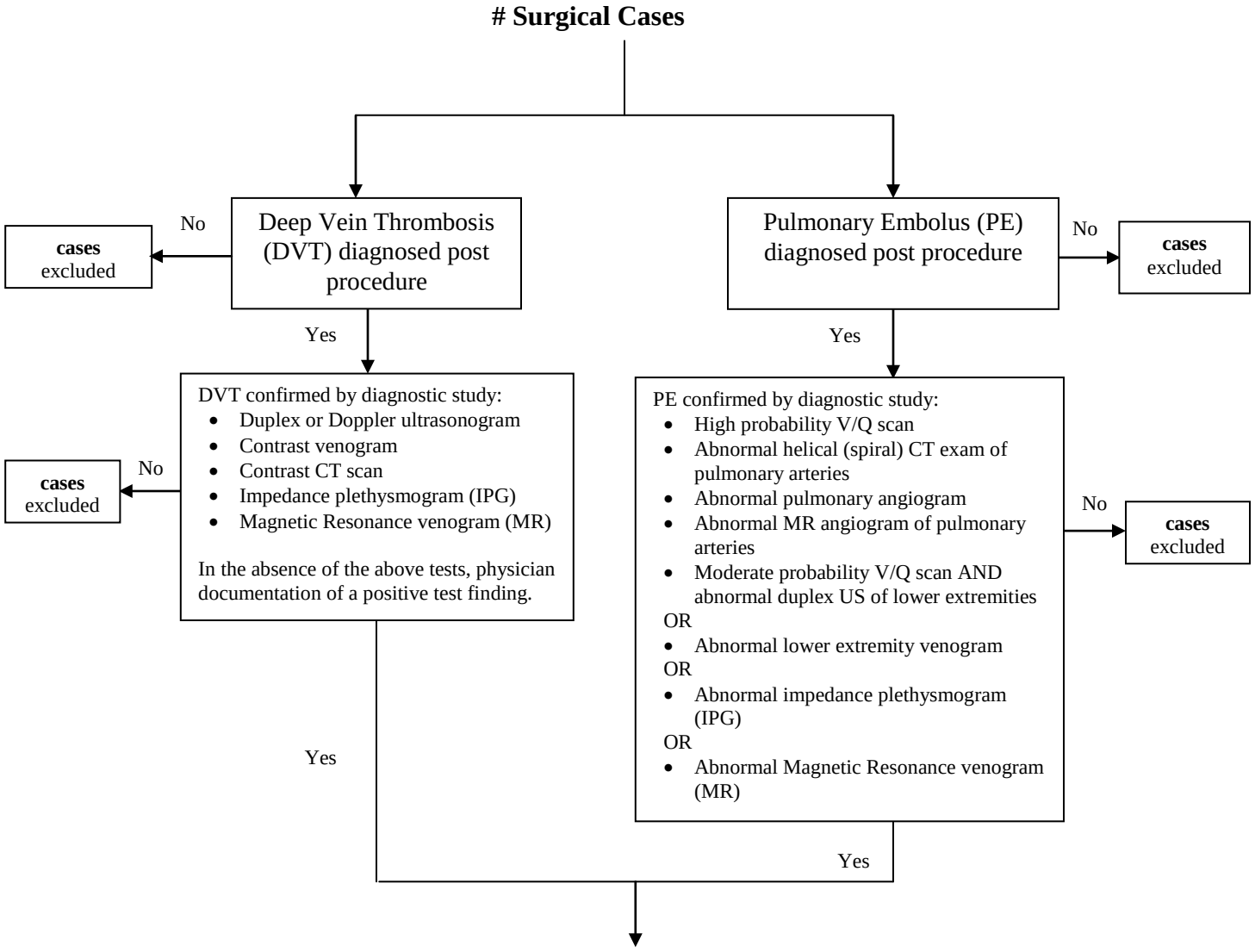
Postoperative Pneumonia

 # Surgical Cases



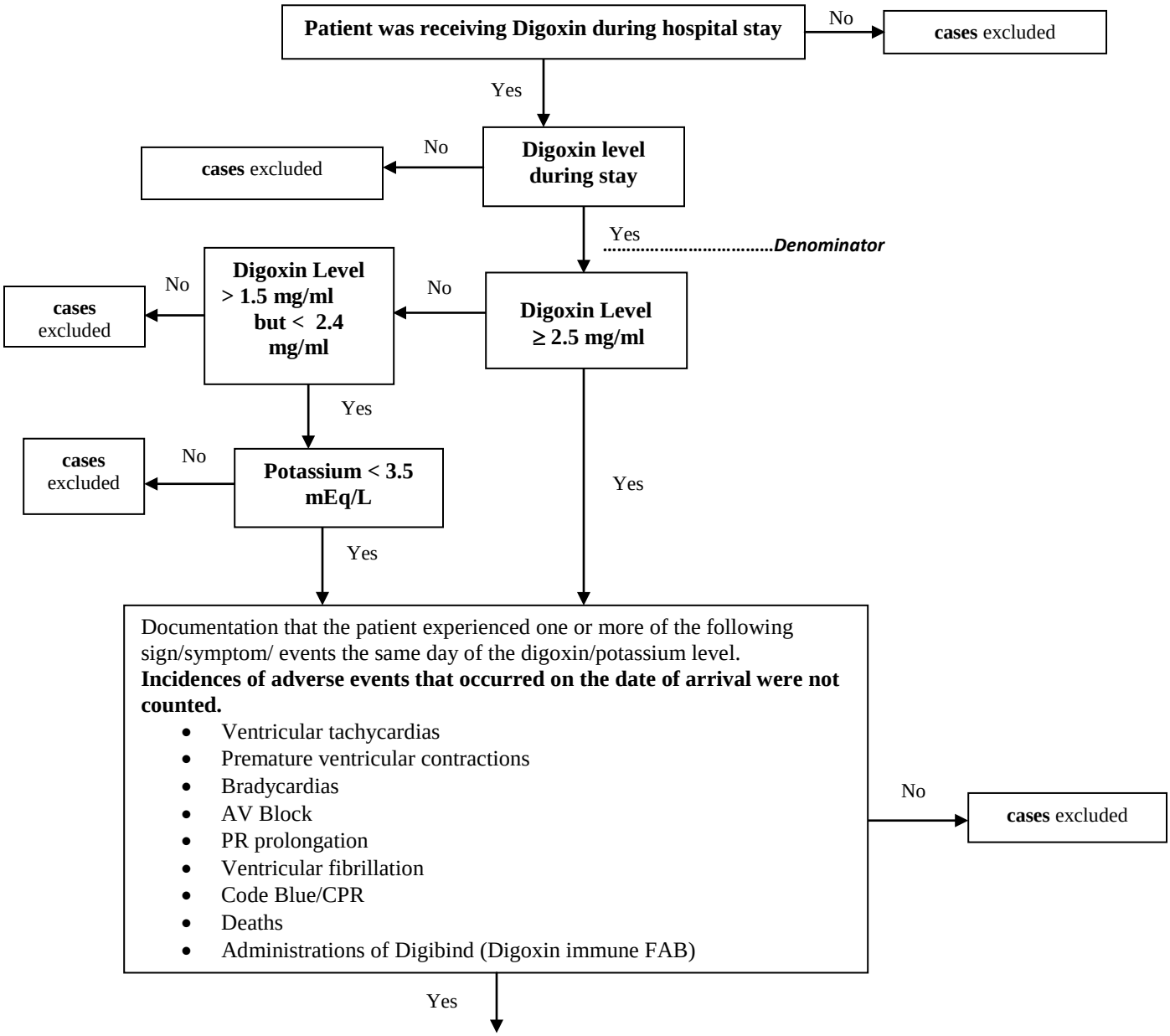
<u># Patients who had Postoperative Pneumonia</u>

Postoperative Venous Thromboembolic Events



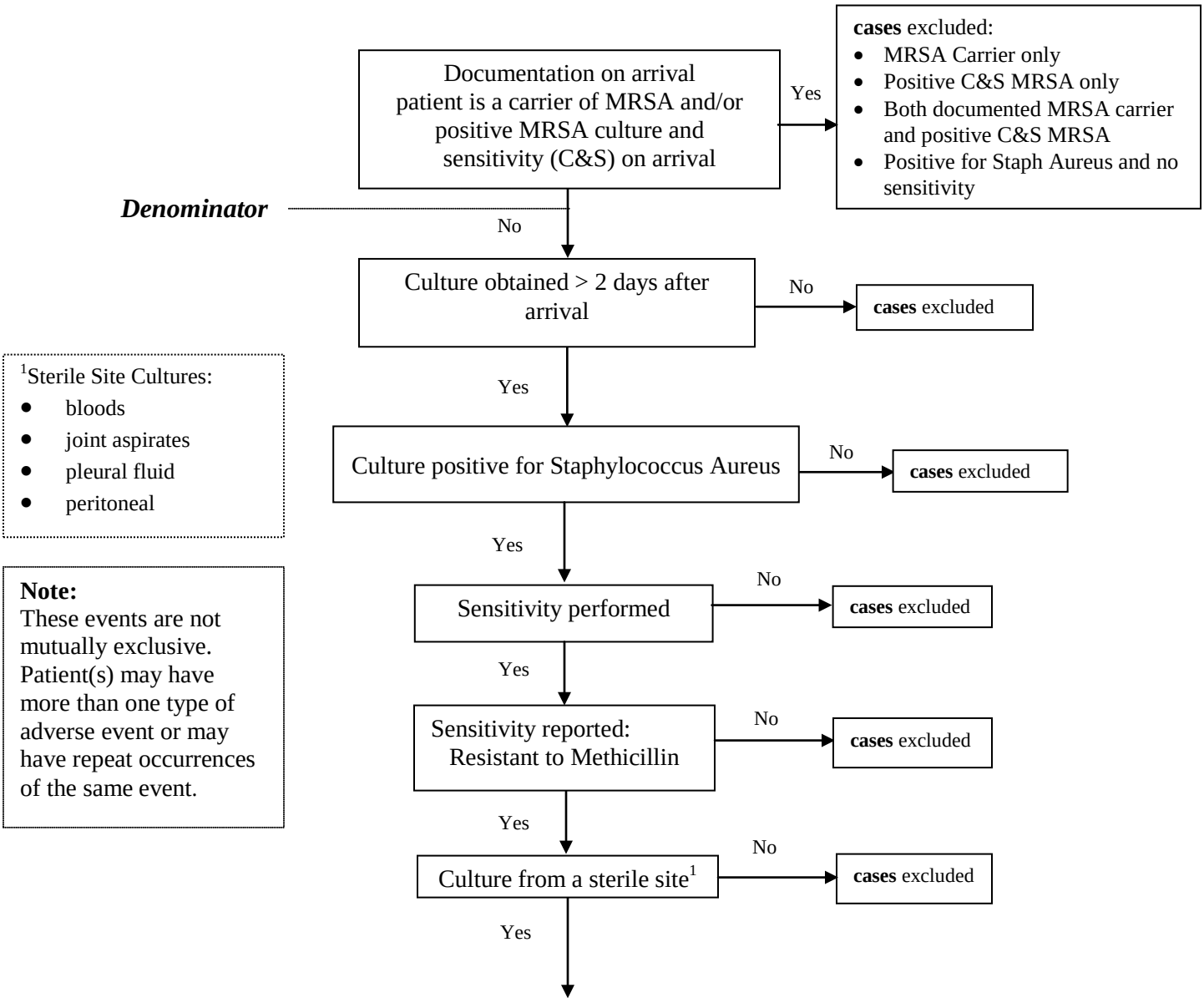
Adverse Events Associated with Digoxin

Hospital Discharges



Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus (MRSA)

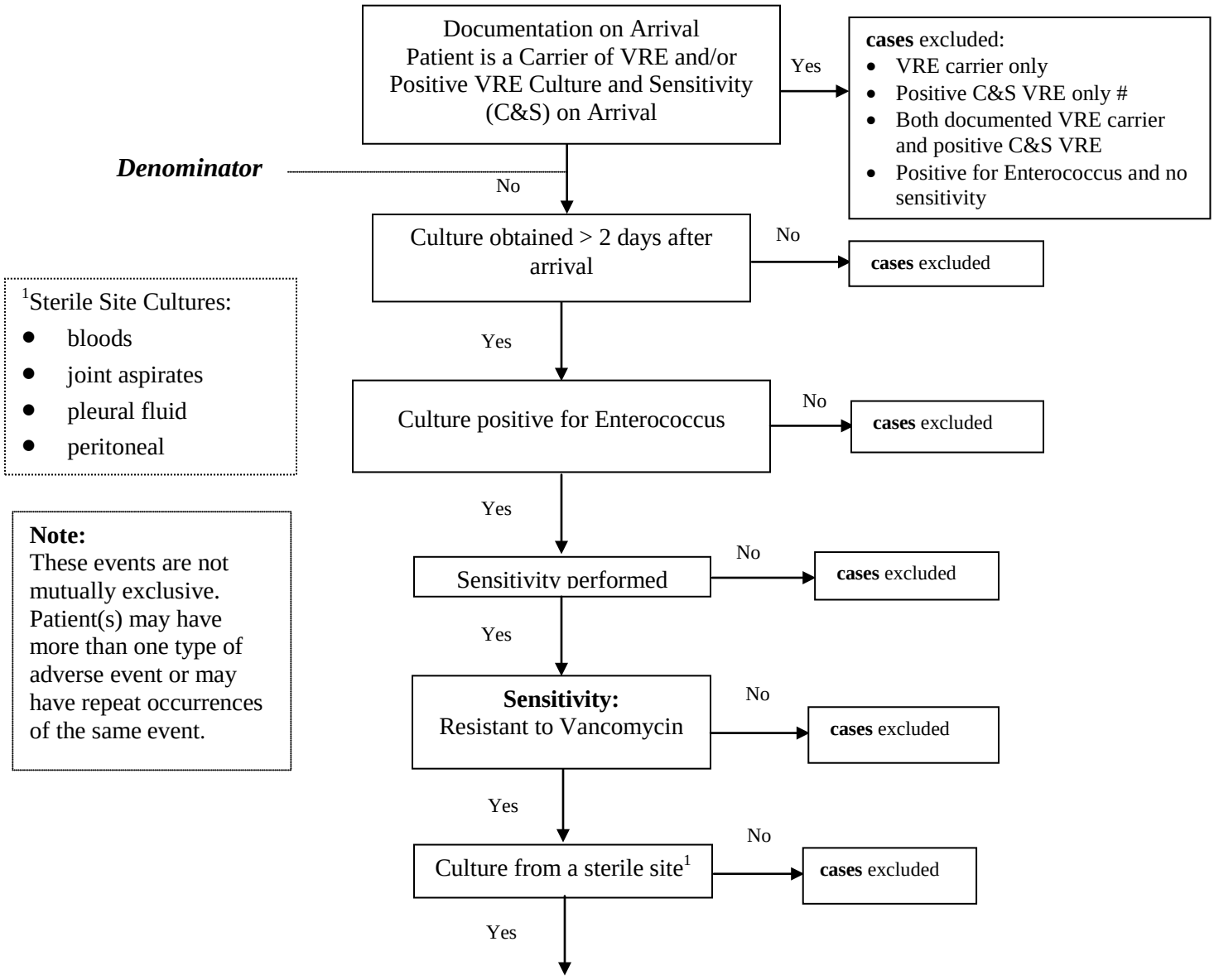
 # Hospital Discharges



 # Patients who acquired MRSA (sterile site cultures only) during the index hospital stay

Hospital-Acquired Vancomycin-Resistant Enterococcus (VRE)

 # Hospital Discharges



 # Patients who acquired VRE (sterile site cultures only) during the index hospital stay

Appendix C: Approaches to Address Change in Data Sources

As discussed in Appendix A, the data source for MPSMS changed in 2009. As a result of this change, we identified two potential challenges: 1) the inclusion of more records for the 2009-2011period than the 2005-2007 period, and 2) potential bias due to variation in hospitals sampled over time. To address these challenges, we conducted additional analyses. First, to focus on the difference in sample sizes between 2005-2007 and 2009-2011, we conducted a sensitivity analysis using the nonparametric bootstrap method to generate 3,000 subsamples with replacements from the 2009, 2010, and 2011 data. The sample size of the 3,000 subsamples was approximately the same as the average sample size of the 2005, 2006, and 2007 data. We then linked each subsample to the 2005, 2006, and 2007 data and fitted the mixed models to estimate the annual changes in adverse event rates. The simulation analysis showed that the difference in sample sizes between 2005-2007 and 2009-2011 periods did not impact the estimate of annual changes in adverse event rates (Figure S4).

To address the possibility of different hospitals being sampled over time, we restricted the data to 2005-2006 and 2010-2011, the beginning period and the ending period of the study, and identified hospitals that were in both periods (e.g., a hospital could be sampled in either 2005 or 2006 and again in either 2010 or 2011). For AMI, CHF, pneumonia, and conditions requiring surgery, respectively: 395 (20.0% of total hospitals) had at least one AMI case, 668 (28.0% of total hospitals) had at least one CHF case), 740 (30.6% of total hospitals) had at least one pneumonia case, and 760 (32.4% of total hospitals) had at least one conditions requiring surgery case in both periods of 2005-2006 and 2010-2011. These hospitals accounted for 38.9% of total patients in the whole sample (27.0% for AMI, 38.3% for CHF, 38.8% for pneumonia, and 47.3% for conditions requiring surgery). We then fitted the mixed models based on this subset of

patients, who were discharged from hospitals that were sampled in both the beginning and the end of the study period. Figure S5 shows the results that the patterns of changes in adverse event rates between this subsample and the full sample are similar (Figure 1), indicating the impact of change in the sampling approach on the findings is minor.

Appendix D: Sensitivity Analysis of Changes in Daily Risk of an Adverse Event over Time

Adverse event rates may be associated with length of stay. The relationship between adverse events and length of stay is complex. An adverse event may result in increased length of stay, and a longer length of stay may provide increased opportunities to experience or develop an adverse event. Furthermore, many studies have demonstrated that patients receive the most "intensive" care during the initial days of the hospital stay, so the lower length of stay would probably not result in a proportionate decline in adverse event rates.

Because the MPSMS data does not have the occurrence date/time information for all the 21 adverse event measures, we are unable to conduct a time to event analysis. Moreover, an analysis of daily risk of adverse events could be biased since the number of risks per individual patient may change daily (e.g., if a patient first received Warfarin on the 3rd day of hospitalization, this patient would not be at risk for a Warfarin-related adverse event during the first two days). Nevertheless, we did conduct a sensitivity analysis of changes in daily risk of an adverse event over time. We used the outcome of at least one adverse event per hospitalization over the study period. The percentages of annual changes in daily risk of at least one adverse event were -0.13% (95% CI -0.24 to -0.009) for AMI, -0.03% (95% CI -0.10 to 0.05) for CHF, 0.02% (95% CI -0.04 to 0.08) for pneumonia, and 0.05% (95% CI -0.003 to 0.11)) for conditions requiring surgery (Figure S6).

Figure S1. Distribution of the Number of Adverse Events for which Patients were at Risk during Hospitalizations from 2005 to 2011, except 2008.

Each patient was at risk for at least two adverse events: in-hospital falls and hospital-acquired pressure ulcers.

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure.

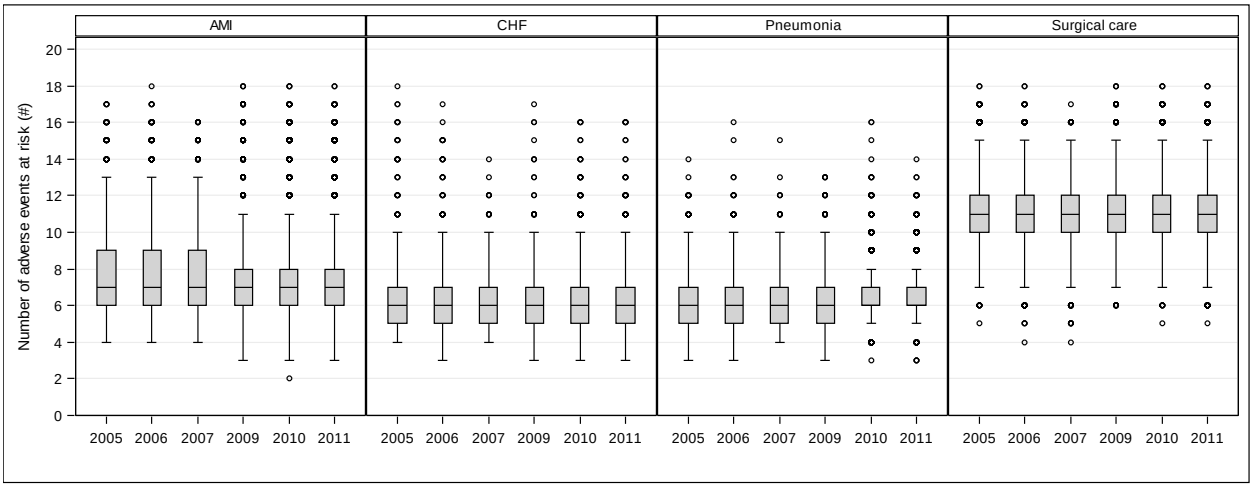


Figure S2. Relative Changes in Observed Adverse Event Rates between 2005 and 2011.

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure.

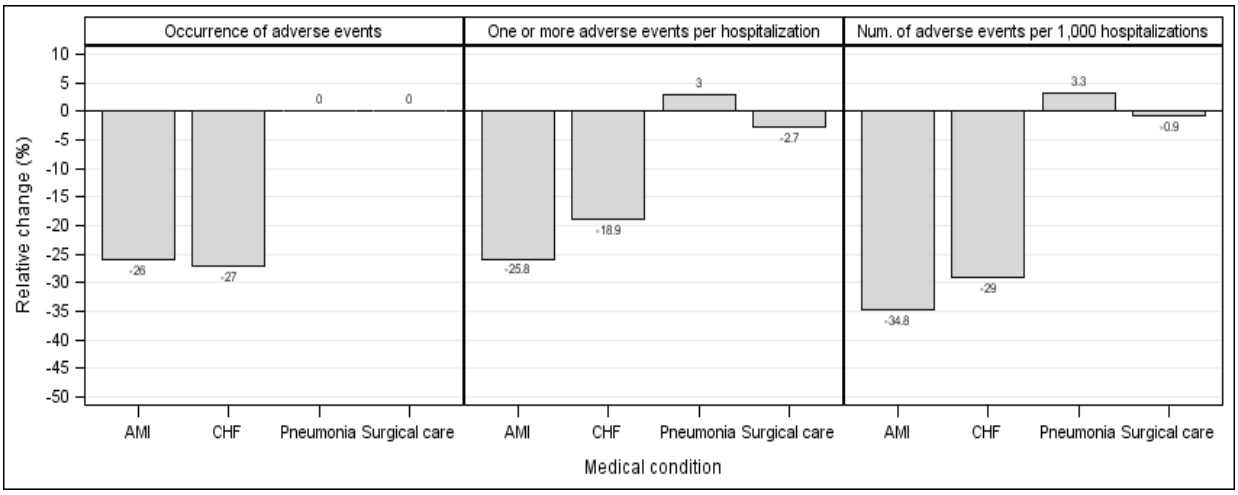


Figure S3. Age and Comorbidities Adjusted Annual Changes in Adverse Event Rates by Gender-Race Subgroups.

The changes in the rate of occurrence of adverse events and the rate of patients with one or more adverse events were expressed as an adjusted relative risk ratio (RR) of the ordinal time variable, ranging from 0 to 5, corresponding to year 2005 to year 2011 (except 2008). An RR less than 1 indicates that a rate has declined over time. The change in the number of adverse events that occurred per 1,000 hospitalizations was expressed as an adjusted incidence risk ratio (IRR) of an ordinal time variable, ranging from 0 to 5, corresponding to year 2005 to year 2011 (except 2008). An IRR less than 1 indicates that the number of adverse events has decreased over time.

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure.

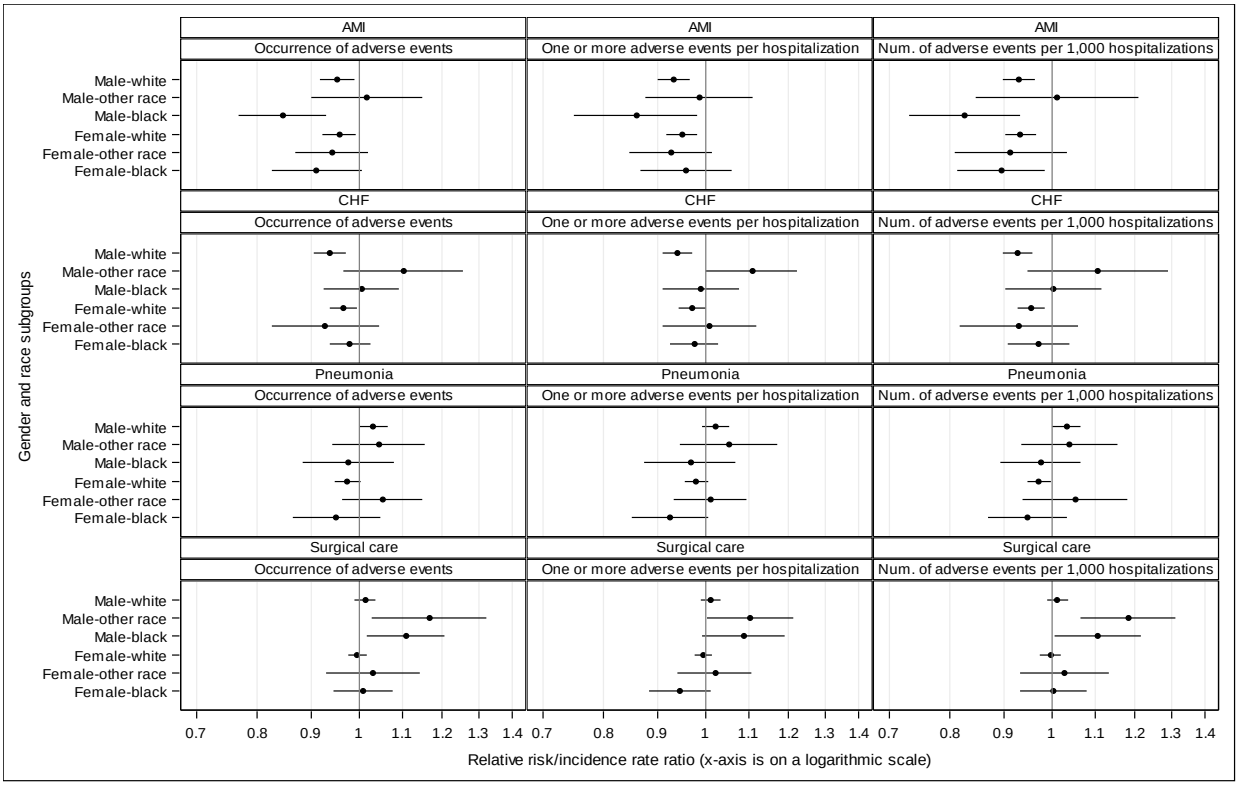


Figure S4. Distributions of Adjusted Annual Declines (%) in Adverse Event Rates obtained from Bootstrap Analysis.

The x-axis represents the age-sex-race-comorbidities adjusted annual percent declines in three adverse event outcomes for acute myocardial infarction, congestive heart failure, pneumonia, and conditions requiring surgery. A value greater than 0 indicates that an adverse event rate has declined over time, while a value less than 0 indicates that an adverse event rate has increased over time.

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure.

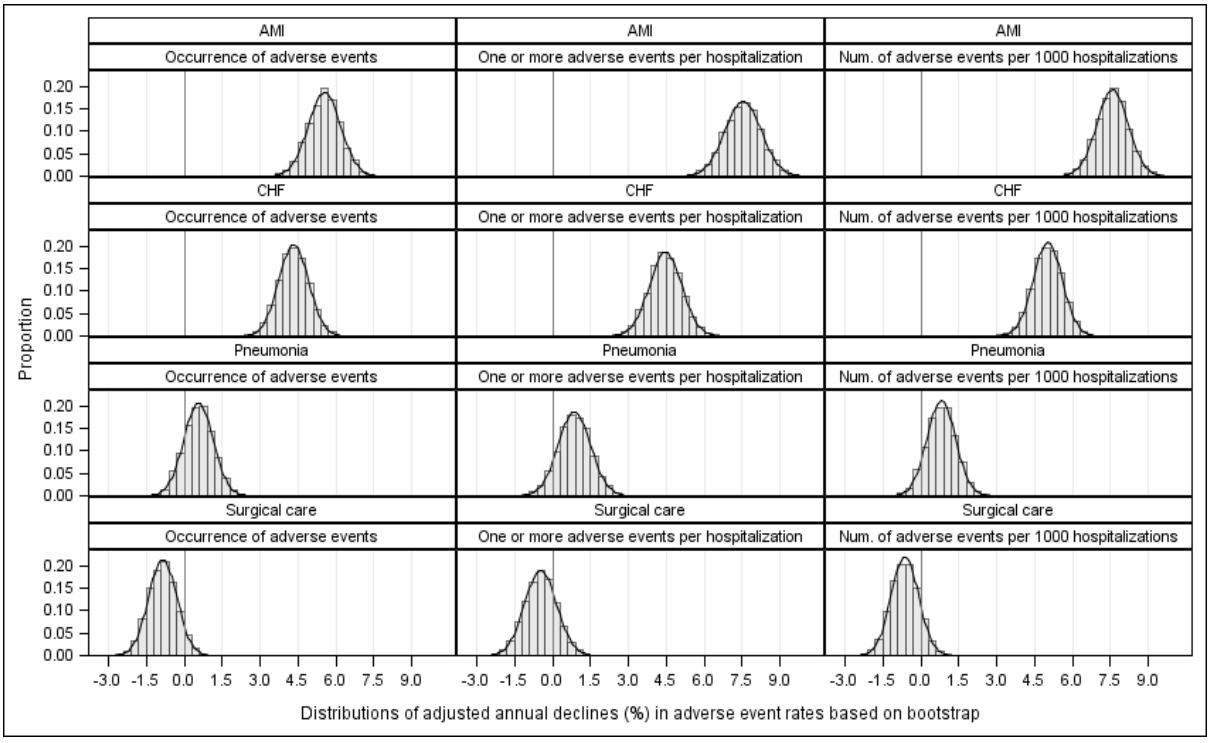


Figure S5. Adjusted Annual Changes in Adverse Event Rates between 2005-2006 and 2010-2011 (only hospitals represented in both 2005-2006 and 2010-2011 periods were included).

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure.

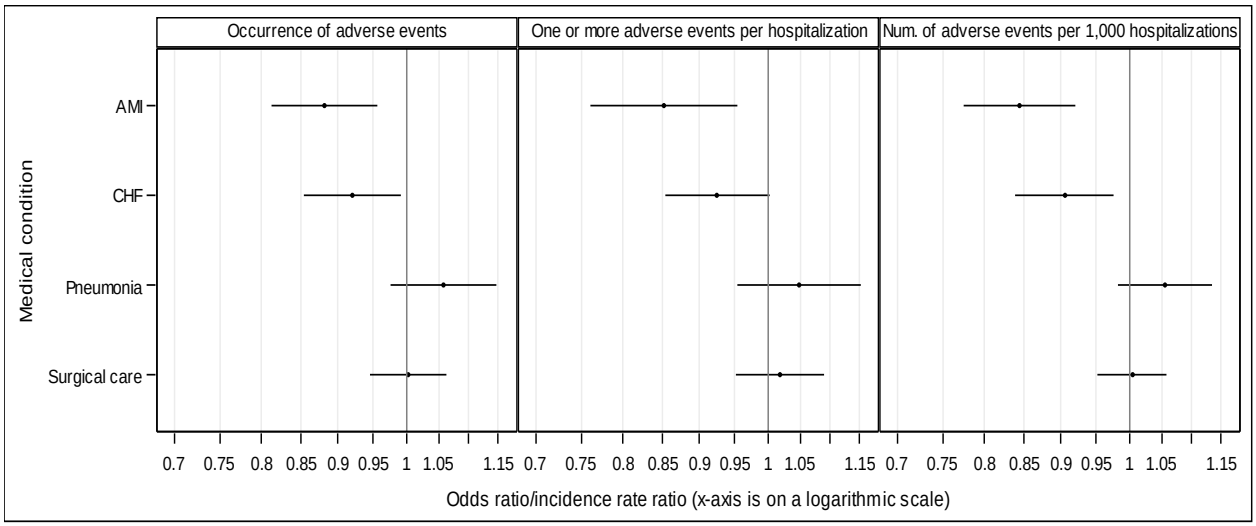


Figure S6. Adjusted Annual Changes in Daily Risk of Adverse Events (outcome of at least one adverse event per hospitalization over the study period).

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure.

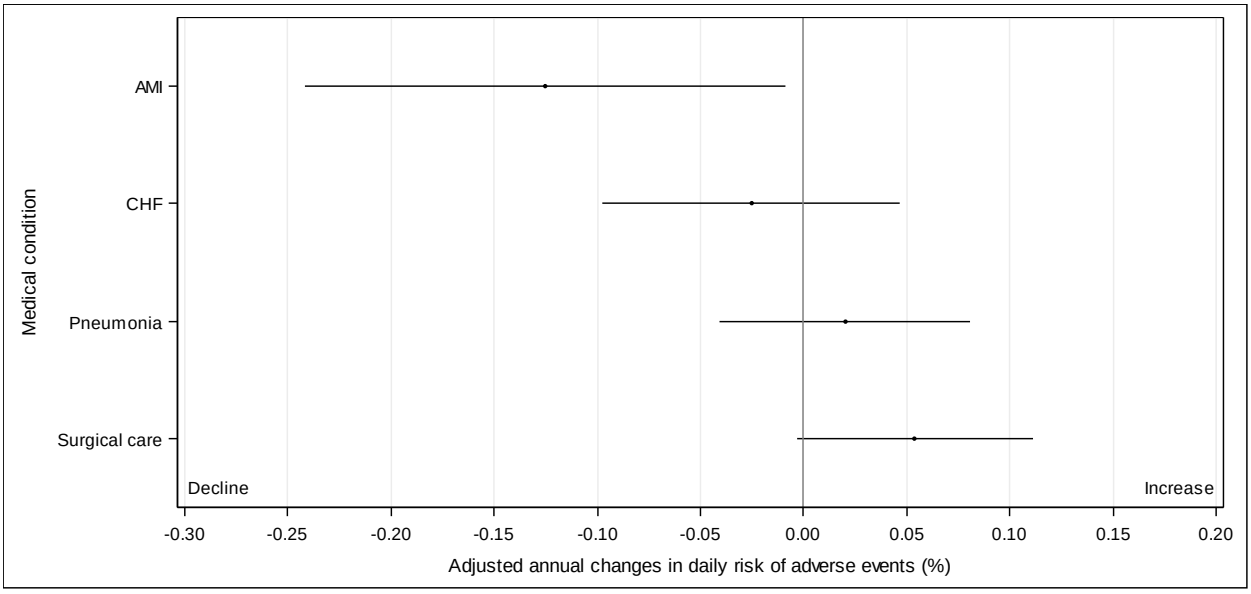


Table S1. List of the 21 Adverse Event Measures

Adverse Events for which patients were at risk during hospitalizations	Domain	Data Available Period
Adverse Events Associated with Digoxin	Adverse drug event	2004-2011
Adverse Events Associated with Hypoglycemic Agents	Adverse drug event	2004-2011
Adverse Events Associated with Heparin	Adverse drug event	2004-2011
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitors	Adverse drug event	2004-2011
Adverse Events Associated with Warfarin	Adverse drug event	2004-2011
Hospital-Acquired Pressure Ulcers	General	2004-2011
Inpatient Falls	General	2005-2011
Central Line-Associated Blood Stream Infections	Hospital-acquired infection	2002-2011
Postoperative Pneumonia	Hospital-acquired infection	2002-2011
Hospital-Acquired Antibiotic-Associated Clostridium difficile	Hospital-acquired infection	2004-2011
Catheter-Associated Urinary Tract Infections	Hospital-acquired infection	2005-2011
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	Hospital-acquired infection	2005-2011
Hospital-Acquired Vancomycin-Resistant Enterococcus	Hospital-acquired infection	2005-2011
Ventilator-Associated Pneumonia	Hospital-acquired infection	2005-2011
Adverse Events Associated with Hip Joint Replacement	Post-procedure	2002-2011
Adverse Events Associated with Knee Joint Replacement	Post-procedure	2002-2011
Mechanical Complications Associated with Central Lines	Post-procedure	2002-2011
Postoperative Venous Thromboembolic Events	Post-procedure	2002-2011
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	Post-procedure	2004-2011
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	Post-procedure	2005-2011
Contrast Nephropathy Associated with Catheter Angiography	Post-procedure	2005-2011

Table S2. Illustration of Calculating of the Three Outcomes

Characteristic	Patient ID				Total	Rate of occurrence of adverse events± (%)	Rate of patients with one or more adverse events¶ (%)	Number of adverse events per 1,000 hospitalizations§ (#)
	A	B	C	D				
Number of adverse events that occurred during a hospitalization (#)	2	1	0	0	3			
Number of adverse events for which a patient was at risk during a hospitalization (#)	8	7	4	9	28			
Number of patients (#)	1	1	1	1	4	3÷28×100=10.7%	2÷4×100=50.0%	3÷4×1000=750

±The numerator is the number of adverse events that occurred and the denominator is the number of adverse events for which patients were at risk;

¶The numerator is the number of patients who experienced one or more adverse events and the denominator is the number of hospitalizations;

§The numerator is the number of adverse events that occurred and the denominator is the number of hospitalizations.

Table S3. Hospitals in the Final Study Sample, 2005 to 2011

Year	Overall hospital information in the final study sample						By condition							
		Number of cases (#)			With at least one case for each condition‡		Number of hospitals with at least one case for any condition (#)¥							
	Hospitals in final sample(#)±	Median	Quartile, Q1 to Q3	Min to max	Total (#)	Repeated (#)§	Acute Myocardial Infarction	Repeated (#)¶	Congestive Heart Failure	Repeated (#)¶	Pneumonia	Repeated (#)¶	Conditions Requiring Surgery	Repeated (#)¶
2005	1963	2	1 to 3	1 to 61	124	NA	494	NA	891	NA	965	NA	1074	NA
2006	1822	2	1 to 4	1 to 64	125	51	438	167	847	356	897	406	1031	617
2007	1856	2	1 to 3	1 to 66	112	35	433	90	861	216	899	253	1051	464
2009	3842	2	1 to 3	1 to 9	76	0	1227	50	1547	73	2199	116	1655	259
2010	1377	12	6 to 20	1 to 36	955	0	1189	19	1210	28	1260	47	1176	100
2011	1372	12	6 to 19	1 to 36	888	0	1134	9	1209	18	1249	33	1131	68

± For patients aged 65 years or older, Medicare fee-for-service only, and with one of the four conditions (there were 4,372 unique hospitals from 2005 to 2011).

‡ Acute myocardial infarction, congestive heart failure, pneumonia, and conditions requiring surgery.

§ Number of hospitals repeated in each year, 2005 as a baseline year (e.g., among the 124 hospitals in 2005 with at least one case for each of the 4 conditions, 51 repeated in 2006, 35 repeated in both 2006 and 2007, none repeated in 2006, 2007 and 2009, and none repeated in 2006, 2007, 2009, and 2010-2011).

¶ Number of hospitals repeated in each year, 2005 as a baseline year (e.g., among the 494 hospitals in 2005 with at least one AMI case, 167 repeated in 2006, 90 repeated in 2006 and 2007, 50 repeated in 2006,2007, and 2009, 19 repeated in 2006,2007, 2009, and 2010, and 9 repeated in 2006,2007,2009,2010, and 2011).

¥ Hospitals in each condition were not mutually exclusive.

NA: Not applicable.

Table S4. Patient Characteristics, 2005-2006 to 2010-2011

Patient characteristics	Acute Myocardial Infarction			Congestive Heart Failure			Pneumonia			Conditions Requiring Surgery		
	2005-2006	2007-2009¶	2010-2011	2005-2006	2007-2009¶	2010-2011	2005-2006	2007-2009¶	2010-2011	2005-2006	2007-2009¶	2010-2011
Total, no.	1360	2223	7816	2689	3268	9417	2889	4900	10480	4814	4855	7594
Age, mean (SD) years	78.3 (8.2)	79.1 (8.5)	79.6 (8.7)***	79.7 (7.9)	80.8 (8.2)	80.6 (8.2)***	79.5 (8.0)	79.8 (8.4)	79.6 (8.5)	75.4 (6.9)	75.3 (7.0)	75.4 (7.3)
Female, no. (%)	702 (51.6)	1085 (48.8)	4076 (52.1)	1511 (56.2)	1857 (56.8)	5236 (55.6)	1569 (54.3)	2645 (54.0)	5529 (52.8)	2677 (55.6)	2834 (58.4)	4468 (58.8)**
Race group, no. (%)						*			**			***
White	1226 (90.1)	1927 (86.7)	6892 (88.2)	2226 (82.8)	2764 (84.6)	8013 (85.1)	2525 (87.4)	4343 (88.6)	9130 (87.1)	4395 (91.3)	4366 (89.9)	6705 (88.3)
Black	73 (5.4)	153 (6.9)	570 (7.3)	304 (11.3)	351 (10.7)	981 (10.4)	186 (6.4)	278 (5.7)	826 (7.9)	222 (4.6)	267 (5.5)	492 (6.5)
Other race	61 (4.5)	143 (6.4)	354 (4.5)	159 (5.9)	153 (4.7)	423 (4.5)	178 (6.2)	279 (5.7)	524 (5.0)	197 (4.1)	222 (4.6)	397 (5.2)
Comorbidities, no. (%)												
History of heart failure	644 (47.4)	1101 (49.5)	3973 (50.8)*	2643 (98.3)	3208 (98.2)	9295 (98.7)*	1268 (43.9)	2038 (41.6)	4429 (42.3)	714 (14.8)	736 (15.2)	1224 (16.1)*
Obesity	168 (12.4)	336 (15.1)	1292 (16.5)***	398 (14.8)	565 (17.3)	2054 (21.8)***	262 (9.1)	539 (11.0)	1581 (15.1)***	588 (12.2)	823 (17.0)	1785 (23.5)***
Coronary artery disease	1313 (96.5)	2158 (97.1)	7678 (98.2)***	1858 (69.1)	2155 (65.9)	6427 (68.2)	1172 (40.6)	2183 (44.6)	4835 (46.1)**	1816 (37.7)	1786 (36.8)	2810 (37.0)
Renal disease	472 (34.7)	731 (32.9)	2863 (36.6)*	1232 (45.8)	1393 (42.6)	4537 (48.2)**	844 (29.2)	1407 (28.7)	3566 (34.0)***	729 (15.1)	656 (13.5)	1217 (16.0)
Cerebrovascular disease	280 (20.6)	521 (23.4)	2011 (25.7)***	645 (24.0)	795 (24.3)	2300 (24.4)	634 (21.9)	1099 (22.4)	2509 (23.9)*	701 (14.6)	740 (15.2)	1125 (14.8)
Chronic Obstructive Pulmonary Disease	363 (26.7)	569 (25.6)	2168 (27.7)	1101 (40.9)	1314 (40.2)	4110 (43.6)**	1663 (57.6)	2583 (52.7)	5312 (50.7)***	1016 (21.1)	849 (17.5)	1413 (18.6)**
Cancer	288 (21.2)	427 (19.2)	1514 (19.4)	487 (18.1)	637 (19.5)	1984 (21.1)***	781 (27.0)	1316 (26.9)	2885 (27.5)	1516 (31.5)	1448 (29.8)	2146 (28.3)**
Diabetes	532 (39.1)	900 (40.5)	3244 (41.5)	1213 (45.1)	1467 (44.9)	4421 (46.9)*	909 (31.5)	1644 (33.6)	3786 (36.1)***	1202 (25.0)	1289 (26.5)	2220 (29.2)***
Smoking	193 (14.2)	326 (14.7)	1175 (15.0)	254 (9.4)	364 (11.1)	1062 (11.3)*	424 (14.7)	758 (15.5)	1561 (14.9)	492 (10.2)	547 (11.3)	955 (12.6)***

P value for linear trend from 2005-2006 to 2010-2011 (* for P < 0.05, ** for P < 0.01, and *** for P < 0.001)

¶ Except 2008

Table S5. At Risk Population, 2005-2006 to 2010-2011

Domain and Adverse Events	Acute Myocardial Infarction			Congestive Heart Failure			Pneumonia			Conditions Requiring Surgery		
	2005-2006 (n=1360)	2007-2009 (n=2223) ¶	2010-2011 (n=7816)	2005-2006 (n=2689)	2007-2009 (N=3268) ¶	2010-2011 (N=9417)	2005-2006 (n=2889)	2007-2009 (n=4900) ¶	2010-2011 (n=10480)	2005-2006 (n=4814)	2007-2009 (n=4855) ¶	2010-2011 (n=7594)
Adverse drug events, no.±(%)‡												
Adverse Events Associated with Digoxin	85 (6.3)	124 (5.6)	398 (5.1)	514 (19.1)	393 (12.0)	963 (10.2)	310 (10.7)	370 (7.6)	628 (6.0)	187 (3.9)	126 (2.6)	215 (2.8)
Adverse Events Associated with Hypoglycemic Agents	550 (40.4)	866 (39.0)	3033 (38.8)	1062 (39.5)	1288 (39.4)	3946 (41.9)	1012 (35.0)	1685 (34.4)	3921 (37.4)	1613 (33.5)	1650 (34.0)	2710 (35.7)
Adverse Events Associated with IV Heparin	540 (39.7)	625 (28.1)	2123 (27.2)	189 (7.0)	132 (4.0)	301 (3.2)	99 (3.4)	95 (1.9)	284 (2.7)	567 (11.8)	258 (5.3)	437 (5.8)
Adverse Events Associated with Low Molecular Weight Heparin and Factor Xa Inhibitor	566 (41.6)	962 (43.3)	3658 (46.8)	731 (27.2)	973 (29.8)	3317 (35.2)	750 (26.0)	1571 (32.1)	4081 (38.9)	1605 (33.3)	2055 (42.3)	3748 (49.4)
Adverse Events Associated with Warfarin	150 (11.0)	231 (10.4)	693 (8.9)	727 (27.0)	798 (24.4)	2335 (24.8)	426 (14.7)	683 (13.9)	1441 (13.8)	1555 (32.3)	1420 (29.2)	2056 (27.1)
General, (%)†												
Hospital-Acquired Pressure Ulcers	1360 (100.0)	2223 (100.0)	7816 (100.0)	2689 (100.0)	3268 (100.0)	9417 (100.0)	2889 (100.0)	4900 (100.0)	10480 (100.0)	4814 (100.0)	4855 (100.0)	7594 (100.0)
Inpatient Falls	1360 (100.0)	2223 (100.0)	7816 (100.0)	2689 (100.0)	3268 (100.0)	9417 (100.0)	2889 (100.0)	4900 (100.0)	10480 (100.0)	4814 (100.0)	4855 (100.0)	7594 (100.0)
Infection, (%)†												
Hospital-Acquired Antibiotic-Associated Clostridium difficile	587 (43.2)	955 (43.0)	3484 (44.6)	1283 (47.7)	1642 (50.2)	4878 (51.8)	2850 (98.7)	4841 (98.8)	10361 (98.9)	4703 (97.7)	4781 (98.5)	7558 (99.5)
Central Line-Associated Bloodstream Infections	205 (15.1)	273 (12.3)	743 (9.5)	124 (4.6)	101 (3.1)	338 (3.6)	40 (1.4)	38 (0.8)	109 (1.0)	1175 (24.4)	1039 (21.4)	1489 (19.6)
Catheter-Associated Urinary Tract Infections	586 (43.1)	780 (35.1)	2673 (34.2)	1147 (42.7)	1284 (39.3)	3459 (36.7)	952 (33.0)	1416 (28.9)	3171 (30.3)	3959 (82.2)	3905 (80.4)	6357 (83.7)
Hospital-Acquired Methicillin-Resistant Staphylococcus Aureus	1348 (99.1)	2179 (98.0)	7629 (97.6)	2653 (98.7)	3190 (97.6)	9179 (97.5)	2728 (94.4)	4612 (94.1)	9808 (93.6)	4776 (99.2)	4793 (98.7)	7507 (98.9)
Hospital-Acquired Vancomycin-Resistant Enterococcus	1359 (99.9)	2219 (99.8)	7794 (99.7)	2678 (99.6)	3253 (99.5)	9383 (99.6)	2855 (98.8)	4861 (99.2)	10384 (99.1)	4802 (99.8)	4834 (99.6)	7574 (99.7)
Postoperative Pneumonia	151 (11.1)	156 (7.0)	334 (4.3)	54 (2.0)	27 (0.8)	26 (0.3)	6 (0.2)	10 (0.2)	30 (0.3)	4559 (94.7)	4652 (95.8)	7248 (95.4)
Ventilator-Associated Pneumonia	57 (4.2)	78 (3.5)	191 (2.4)	21 (0.8)	15 (0.5)	49 (0.5)	50 (1.7)	48 (1.0)	193 (1.8)	167 (3.5)	167 (3.4)	310 (4.1)
Post-procedure, (%)†												
Adverse Events Associated with Femoral Artery Puncture for Catheter Angiographic Procedures	747 (54.9)	967 (43.5)	2586 (33.1)	165 (6.1)	113 (3.5)	359 (3.8)	18 (0.6)	22 (0.4)	75 (0.7)	482 (10.0)	363 (7.5)	566 (7.5)
Adverse Events Associated with Hip Joint Replacements	2 (0.1)	1 (<0.1)	3 (<0.1)	0	0	1 (<0.1)	0	2 (<0.1)	3 (<0.1)	826 (17.2)	938 (19.3)	1649 (21.7)
Adverse Events Associated with Knee Joint Replacements	0	0	0	0	0	0	0	0	0	1254 (26.0)	1336 (27.5)	2158 (28.4)
Contrast Nephropathy Associated with Catheter Angiography	744 (54.7)	938 (42.2)	2570 (32.9)	184 (6.8)	103 (3.2)	345 (3.7)	60 (2.1)	19 (0.4)	69 (0.7)	528 (11.0)	367 (7.6)	577 (7.6)
Mechanical Complications Associated with Central Lines	241 (17.7)	344 (15.5)	965 (12.3)	164 (6.1)	171 (5.2)	560 (5.9)	341 (11.8)	472 (9.6)	1570 (15.0)	1374 (28.5)	1235 (25.4)	1845 (24.3)
Postoperative Cardiac Events (Cardiac and Non-cardiac Surgeries)	169 (12.4)	169 (7.6)	356 (4.6)	69 (2.6)	29 (0.9)	31 (0.3)	61 (2.1)	37 (0.8)	74 (0.7)	4712 (97.9)	4764 (98.1)	7460 (98.2)
Postoperative Venous Thromboembolic Event	169 (12.4)	169 (7.6)	356 (4.6)	69 (2.6)	29 (0.9)	31 (0.3)	61 (2.1)	37 (0.8)	74 (0.7)	4712 (97.9)	4764 (98.1)	7460 (98.2)
Composite												
Overall adverse event rate, no. (%)	10976 (38.4)	16482 (35.3)	55221(33.6)	17212 (30.5)	20077 (29.3)	58335 (29.5)	18397 (30.3)	30619 (29.8)	67236 (30.6)	53184 (52.1)	53157 (51.6)	84112 (51.9)

One or more adverse events per hospitalization, no. (%)	1360 (100.0)	2223 (100.0)	7816 (100.0)	2689 (100.0)	3268 (100.0)	9417 (100.0)	2889 (100.0)	4900 (100.0)	10480 (100.0)	4814 (100.0)	4855 (100.0)	7594 (100.0)
Number of adverse events per 1,000 hospitalizations, no. (#)	1360 (100.0)	2223 (100.0)	7816 (100.0)	2689 (100.0)	3268 (100.0)	9417 (100.0)	2889 (100.0)	4900 (100.0)	10480 (100.0)	4814 (100.0)	4855 (100.0)	7594 (100.0)

† Number of patients who were at risk for the index adverse event;

‡ Percentage of patients who were at risk for the index adverse event

NA: No rate was computed.

¶ Except 2008.

Table S6. Percentage of Patients at Risk for Seven or More Adverse Events during a Hospitalization, 2005-2006 to 2010-2011

Condition	2005-2006		2007-2009¶		2010-2011		P value
	Total† (#)	Rate‡ (%)	Total† (#)	Rate‡ (%)	Total† (#)	Rate‡ (%)	
Acute Myocardial Infarction	1360	69.3	2223	58.5	7816	51.9	<0.001
Congestive Heart Failure	2689	39.3	3268	34.9	9417	36.6	0.092
Pneumonia	2889	36.8	4900	35.1	10480	40.6	<0.001
Conditions Requiring Surgery	4814	99.3	4855	99.3	7594	99.5	0.087

† Total number of patients
‡ Percentage of patients at risk for seven or more adverse events during a hospitalization
¶ Except 2008

Table S7. Fall Related Injuries - 2011

Outcome±	Acute Myocardial Infarction		Congestive Heart failure		Pneumonia		Conditions Requiring Surgery	
	Total (#)	Rate (%)	Total (#)	Rate (%)	Total (#)	Rate (%)	Total (#)	Rate (%)
Falls	31	100.0	50	100.0	70	100.0	41	100.0
New fracture	2	6.5	5	10.0	1	1.4	0	0.0
Subdural hematoma	0	0.0	0	0.0	1	1.4	2	4.9
New laceration requiring sutures or staples	0	0.0	1	2.0	3	4.3	1	2.4
New dislocation of a bone or joint	0	0.0	0	0.0	0	0.0	0	0.0
New other injury from fall	2	6.5	9	18.0	12	17.0	4	9.8

± Documented the day of the fall or after the fall during the hospital stay